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ABSTRACT

Eighteen essays discuss applications of geographic research covering a variety of topics and methodologies. All authors are faculty, graduates, or graduate students of the geography department at Michigan State University. The most frequently discussed themes include economic, political, social, and medical uses of geographic research. Two papers explore research techniques using computers and cartography. An exam*le of the variety of topics is provided by the following titles: "Recreational Geography: Its Evolution and Applications to Problems of Wilderness Management," "Man-Water Relationship Research and the Application of the Geographic Approach," "Some Applications of Geomorphic Research to Societal Needs," "Geographers and Asia's Development Problems," and "The Application of Geography to Public Pclicy Analysis: A Case Study." Two philosophical papers conclude the booklet with discussion of the necessity of establishing clear communications links between professional geography and the general public so that knowledge generated by the discipline can be widely and effectively applied. (AV)

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# APPLICATIONS OF GEOGRAPHIC RESEARCH

## Viewpoints from Michigan State University

*Edited by*

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SO010658

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## ERRATA

Page viii: line 3 should read "...Emily Palmer..."
line 5 should read "to all who read galley proofs..."

Page 10, paragraph 3: line 2 should be deleted; first sentence in paragraph should read "As a result of the regional development trends, more and more high value-added and capital intensive firms will decide in the future to locate plants in the South."

Page 18, last paragraph: line 6 should read "...available within a city..."

Page 24: entry 12 in references should read "Cox, K. R. and R. Golledge..."

Page 31, last paragraph: line 5 should read "...may have been created..."

Page 36: 8th line from end of page should read "recorder of deeds or Lusk's..."

Page 56, paragraph 3: line 5 should read "journal entitled *Landscape...*"

Page 80, paragraph 2: line 7 should read "...Lime (1971, 1972) investigated..."

Page 84, paragraph 4: line 5 should read "...areas to which geographers can..."

Page 90, paragraph 2: line 11 should read "resulted in the Tennessee Valley landscape alterations and plans. Another..."

Page 110: entry 16 in references should read "Penman, H. L. *Vegetation and Hydrology...*"

Page 127, section on "Urbanization": line 6 should read "population of the United States and is greater than the total population of Japan. China alone..."

Page 129: line 1 should read "...exists today in the economic"

Page 142: entry 5 in references should read "Marble, Duane F. *Some Computer Programs for Geographic Research...*"

Page 147, paragraph 2: line 12 should read "classes each. Map 6 of the..."

Page 158: caption on figure should read "Figure 2"

Page 159: caption on figure should read "Figure 1"

Page 161, note 2, paragraph 2 should read: Along similar lines...term model "has become very fashionable.... As Brodbeck [1959, 373] has pointed out, model-building has a kind of 'halo effect' upon the research worker since 'Models are Good Things'.... The general confusion...geographic research...."

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## *Preface*

This volume was developed in conjunction with a symposium held at Michigan State University in the spring of 1977. By design, all of the articles were prepared specifically for this publication by faculty, graduates, and graduate students of the Department of Geography, Michigan State University. Each is concerned with particular applications of geographic research. Obviously research in geography varies greatly by topic and methodology, and this is illustrated by the differing content of the articles. As editors, we have attempted to provide a certain consistency in presentation, but we have also tried to preserve each author's individual approach to the subject.

Presented here are the points of view of eighteen geographers writing on a number of themes that range, in order, from economic, political, social, and medical to historical, cultural, recreational, and earth space use. These are followed by articles on climatology, geomorphology, and regional geography; two technique papers, one on the use of computers and the other dealing with an aspect of cartography; and finally two contemporary philosophical statements. The volume is in no way intended to be a complete review of research applications. Instead it presents a number of viewpoints based upon the professional and research experiences of the authors, and most, if not all, of their writings represent a timely assessment rather than a comprehensive overview. Most of the papers are quite specialized, but collectively they demonstrate that geographic research may be applied in many ways. Some also show that missed opportunities, neglect, and philosophical trends of the discipline have all tended to limit the amount of applied geographic research. Yet all, in one way or another, indicate that geographic research holds considerable promise regarding present needs and future opportunities and, if applied meaningfully, will surely enrich and enhance both society and the profession.

### *ACKNOWLEDGMENTS*

Professor Lawrence M. Sommers, Chairman of the Department of Geography, originated the proposal for this volume and the symposium and provided administrative assistance in the development of both. Dr. Gwen Andrew, Dean of the College of Social Science, Michigan State University, supported the project and supplied funding through her office. Kathleen Schoonmaker of University Publications accorded us especially helpful advice and service regarding the printing of the book and related business procedures. Professor Gary Manson, a member of the planning committee for this activity, offered his time and effort most graciously. The departmental Advisory Committee, including Professors Harman, Jacobson, Manson, Williams, and Wittick, gave useful counsel. J. Michael Lipsey

Gary K. Alden, and Daniel A. Dueweke of the Center for Cartographic Research and Spatial Analysis prepared the cover and most of the figures. The university secretaries, Sheila Hoeve, Nancy Howland, Emily Parker, Judy Quinn, and Joan Quarles, were helpful in the typing of manuscripts. Acknowledgments are also due to all who ready galley proofs. To each of these persons, we express our sincere appreciation. Finally, we wish to thank the contributing authors, who were subject to unusually severe time constraints, for their efforts and cooperation.

# *The Application of Geography to Public Policy Analysis: A Case Study*

**BARRY M. MORIARTY**

Barry M. Moriarty received his Ph.D. from Michigan State University and is at present Associate Professor of Geography and Director of the Institute for Economic Development at the University of North Carolina, Chapel Hill. His primary research interests are in urban population and economic development and their geographic distribution.

Geographers, with their concern for location and area analysis and the interrelationships that exist between locationally distributed phenomena, have developed specialized skills, techniques, and principles that are applicable to investigating some of the consequences of public policy decisions. Geographic research on the spatial linkages that exist in association with human activities is particularly useful in the analysis of policies that deal with problems of space management. Among these problems are those associated with agricultural, residential, commercial, industrial, and public land development; urban, regional, transportation, health care, and environmental planning; resource management, foreign trade, and economic development strategies; and the reduction of crime, disease, and poverty in pathologically impacted areas. Not only can geographers aid in assessing the effects of existing policy decisions; but in many cases they are able to help evaluate the economic, social, or environmental impact of alternative policy decisions so that the most appropriate policy programs can be formulated.

The makers of public policy tend to regard geographic space as a medium only rather than as a variable which influences many patterns of human interaction and activity. They generally think of geographic space as the backward, underprivileged, or problem area for which policy programs need to be developed "to promote the general welfare." Little, if any, consideration is given to spatial arrangements and associations of activities and processes that exist in geographical space that may be part of the reason for it being a backward, underprivileged, or problem area in the first place. In good measure this is because many of the processes believed to underlie events do not include spatial variables that may be important in a more accurate explanation. Such nonspatial processes account for the partial influence that space may have in determining an event by including it among the myriad other influences designated as the unexplained residual.

Geography's contribution to the formulation and analysis of public policy can be made by proving that consideration of spatial variables can considerably reduce these unexplained residuals. It can be made by showing that certain spatial variables may have a more significant role in the processes that explain events than the nonspatial variables. And it can be made by demonstrating the importance of spatial sampling techniques which eliminate errors and biases inherent in procedures that do not take into account spatial autocorrelated disturbances in the geographic patterns of the phenomenon being investigated.[1]

The policy analysis reported in this investigation is related to the overall problem of explaining the North-South manufacturing wage differential and the formulating of policy instruments to bring about its convergence. Numerous attempts have been made to explain the wage differential, but they have resulted in an inability to account for the total variation in the dependent variable. Of major importance also is the fact that the differential has persisted throughout the past century despite the regional convergence of variables considered critical to its explanation (Scully 1971; Batra and Scully 1972; Bradfield 1976). Nonetheless, other variables related to regional differences in industrial development patterns have persisted throughout this time.

## *INDUSTRIAL DEVELOPMENT AND ECONOMIC WELL–BEING*

In the past few decades the South has undergone a number of changes that have resulted in its being called the "New South." Several of these changes have been associated with the region's above average growth in urbanization and industrialization (Moriarty 1975, 1976ab). But in spite of these changes the "New South" remains materially poorer than other regions when compared to national standards. One reason given for this discrepancy is that the recent manufacturing growth of the South has been synonymous with the continued expansion of the same low wage, low value-added, slow growth, labor intensive (textile, wood, furniture, apparel) industries that have dominated its manufacturing structure in the past rather than with the expansion of a broader mix of more diversified industries (Hartshorn 1974). An alternative reason offered is that the low degree of trade unionization in the region places constraints on higher earnings, better working conditions, and improved job benefits (Malizia 1975).

In recent years a number of studies have been conducted dealing with the location of manufacturing in the South. Many of these studies have analyzed the reasons why industrial firms have located in the region (Wheeler 1975). Others have researched the relative importance of individual location factors (for example, Lonsdale 1969 and McGregor 1970). A few studies have examined the locational patterns of industry, either collectively or for different types of manufacturing. Few, if any, have investigated the locational patterns of different types of industries established by firms that are either native to the region or native to states outside the region or to foreign countries. An examination of the locational patterns of different types of industry based upon the origin of parent firms, particularly the more recently established ones, can help to explain the continuing distinctiveness of Southern manufacturing and the persistence of the region's low manufacturing wage and poorer level of economic welfare.

In this study one Southern state has been selected for detailed examination: North Carolina. North Carolina is the most industrialized state in the South with substantial employment in the region's traditional labor intensive, low value-added, low wage-paying industries. But because it is the most industrialized state, it leads the region in total value-added by manufacturing. It also ranks among the lowest in the nation in average hourly manufacturing wage as well as in its percentage of unionized workers. The dominance of industry in smaller urban places and rural areas is particularly pronounced in North Carolina as it is throughout the South, yet it contains the third largest industrial market in the region after Baltimore and Atlanta: the Greensboro-Winston-Salem-High Point SMSA (Hartshorn 1974).

This analysis is concerned with determining why some of these conditions exist despite vigorous efforts by public and private development organizations to encourage the growth of more diversified, capital intensive, higher wage-paying industry in the state. The analysis first describes differences in the types of industries established within the state during the recent past by North Carolina, national, and foreign-based parent firms. Second, regional and settlement-size differences in the locational patterns of the different types of industry by origin are discussed. Next, some locational factors that help account for the state's poorer economic well-being are presented. Finally, an examination of the state's industrial development policies and programs is made.

## *CHARACTERISTICS OF INDUSTRIAL PLANTS*

Data were compiled from the *North Carolina Directory of Manufacturing Firms* for all 530 manufacturing plants established in the state during the period 1969-1974 having twenty or more employees (North Carolina Economic Development Division 1975). The Standard Industrial Classification Code assigned to each establishment allowed the plants to be classified as either being above or below the national average in wage rate and value-added by manufacturing. A wage/value-added ratio was calculated and used to classify plants as being either labor or capital intensive.[2] Addresses were used to determine the regional location of the plants within the state (Mountain, Piedmont, or Coastal Plain *state planning region)* and the size of the community in which the plant was located. The employment size of the plant and the location of the parent firm were also compiled from the directory. By origin, 298 plants (56 percent) belonged to North Carolina-based firms, 195 (37 percent) belong to other U.S.-based firms, and 37 (7 percent) belonged to foreign firms (Table 1).

The 530 new plants were very similar to the 3,338 plants employing more than twenty persons that existed in the state at the outset of the period.[3] Seventy percent of the new plants were low wage compared to the 78 percent that existed

### Table 1—CHARACTERISTICS OF NORTH CAROLINA MANUFACTURING PLANTS HAVING TWENTY OR MORE EMPLOYEES

| | Percent of Plants Established in Area < 1969 | Percent of Plants Established in Area by Origin of Parent Firm: 1969-1974 | | | |
|---|---|---|---|---|---|
| | Total Plants N=3338 | Total Plants N=530 | N.C. Plants N=298 | U.S. Plants N=195 | Foreign Plants N=37 |
| Total Industry | | | | | |
| Mountain | 17 | 19 | 16 | 19 | 16 |
| Piedmont | 60 | 46 | 52 | 36 | 51 |
| Coastal Plain | 23 | 35 | 32 | 45 | 33 |
| Places >25,000 | | 29 | 29 | 25 | 49 |
| Places=10-25,000 | | 18 | 18 | 19 | 11 |
| Places <10,000 | | 53 | 53 | 56 | 40 |
| Low Wage | | | | | |
| Total State | 78 | 70 | 79 | 62 | 41 |
| Mountain | 85 | 79 | 88 | 70 | 67 |
| Piedmont | 75 | 69 | 77 | 58 | 37 |
| Coastal Plain | 80 | 67 | 77 | 62 | 33 |
| Places >25,000 | | 59 | 71 | 47 | 33 |
| Places=10-25,000 | | 75 | 85 | 62 | 50 |
| Places <10,000 | | 74 | 85 | 62 | 50 |
| Low Value-Added | | | | | |
| Total State | 78 | 79 | 86 | 70 | 62 |
| Mountain | 84 | 90 | 94 | 86 | 83 |
| Piedmont | 78 | 80 | 88 | 66 | 68 |
| Coastal Plain | 74 | 73 | 82 | 67 | 42 |
| Places >25,000 | | 68 | 84 | 49 | 44 |
| Places=10-25,000 | | 83 | 90 | 76 | 100 |
| Places <10,000 | | 83 | 88 | 78 | 73 |
| Labor Intensive | | | | | |
| Total State | 81 | 88 | 94 | 60 | 73 |
| Mountain | 84 | 88 | 94 | 78 | 100 |
| Piedmont | 83 | 91 | 97 | 80 | 79 |
| Coastal Plain | 71 | 83 | 90 | 80 | 50 |
| Places >25,000 | | 82 | 92 | 67 | 72 |
| Places=10-25,000 | | 92 | 96 | 84 | 75 |
| Places <10,000 | | 90 | 95 | 84 | 73 |
| Small Plants | | | | | |
| Total State | 54 | 59 | 71 | 40 | 61 |
| Mountain | 48 | 55 | 63 | 49 | 50 |
| Piedmont | 56 | 53 | 73 | 42 | 79 |
| Coastal Plain | 53 | 53 | 72 | 34 | 42 |
| Places >25,000 | | 64 | 78 | 39 | 67 |
| Places=10-25,000 | | 53 | 65 | 32 | 75 |
| Places <10,000 | | 58 | 69 | 43 | 53 |

prior to the period. Four-fifths (79 percent) were low value-added compared to 78 percent in 1969. Eighty-eight percent were labor intensive compared to 81 percent, and 59 percent employed less than 100 persons compared to the 54 percent existing prior to the beginning of the period. The percentage of new plants paying higher wages was greater than that for previously existing plants, but a higher percentage were labor intensive, low value-added, small-scale establishments. Consequently the new plants maintained the traditional nature of the state's industrial structure.

Chi-square analysis revealed significant differences between the state-, national-, and foreign-based plants with respect to employment size, wage rate, value-added by manufacturing, and degree of labor intensity. State-based plants primarily employed less than 100 persons (71 percent) as did foreign-based plants (61 percent). Sixty percent of the national-based plants, though, employed more than 100 persons. Most of the state-based plants were low wage payers (79 percent) as were the national-based plants (62 percent). A greater proportion of the foreign-based plants paid higher wages to their workers (59 percent). Regardless of the origin of the parent firm, most plants added less value to their products by manufacturing than the national average: 86 percent of the North Carolina plants, 70 percent of the other U.S. plants, and 62 percent of the foreign plants. State-based plants were primarily labor intensive (94 percent) as were other U.S. plants (80 percent) and foreign plants (73 percent).

## *REGIONAL LOCATION OF PLANTS*

The percentage distribution of new plants locating in each of the state's planning regions was nearly equal to the 1970 percentage distribution of population residing in each region. The largest number of plants located in the Piedmont (46 percent), followed by the Coastal Plain (35 percent) and Mountain regions (19 percent). This contrasted with the regional distribution of previously existing plants in that the Piedmont contained 60 percent of the plants, followed by the Coastal Plain (23 percent) and Mountain regions (17 percent). Thus, relatively fewer new plants located in the Piedmont, but a larger percentage were attracted to the Coastal Plain and even to the Mountains. State and national firms showed statistically significant differences in their choice of a region. State-based firms exhibited a preference for the more urbanized Piedmont region (52 percent) while national firms preferred the more agrarian Coastal Plain (45 percent). State firms were underrepresented in the Coastal Plain and national firms in the Piedmont. Foreign firms were randomly located throughout the state and exhibited no significant regional bias. Because of the employment size differences and regional preferences of state and national firms, the Piedmont attracted smaller-sized plants overall and the inner Coastal Plain larger ones. Even though foreign firms did not exhibit a regional preference, smaller plants also tended to be located in the Piedmont and larger ones in the inner Coastal Plain.

Regardless of origin, plants locating in the Tidewater area of the Coastal Plain were significantly higher value-added types while those locating in the Mountains added less value to their products. In large measure the Tidewater plants resulted from a significant preference on the part of high value-added state and national firms to locate there. Foreign firms exhibited a significant preference to locate high value-added plants in the inner Coastal Plain and low value-added ones in the Mountains. Taken together, significant regional differences existed in the wages paid by all 530 plants. Those locating in the Mountains were primarily low wage paying, while those locating in the Coastal Plain (particularly national firms in the Tidewater) paid higher wages. Overall, plants locating in the Tidewater were significantly more capital intensive, largely because of state-based plants locating there. In summary, the Coastal Plain and especially the Tidewater fared better than the Piedmont and Mountain regions in attracting a greater share of new plants that were high wage, high value-added, capital intensive, large-scale establishments.

## *SETTLEMENT–SIZE LOCATION OF PLANTS*

Seventy-one percent of all new plants were located in places having populations of fewer than 25,000 persons. Fifty-three percent were attracted to places having fewer than 10,000 persons.[4] North Carolina-based firms (56 percent) exhibited the greater tendency to locate plants in places with fewer than 10,000 inhabitants followed by national firms (53 percent). Foreign firms located an equal number of plants in places having fewer than 25,000 persons and more than 25,000 persons. Still, 40 percent of their plants were located in places having fewer than 10,000 persons. The employment size of all 530 plants was found not to be associated with settlement size for the state as a whole.

Capital intensive plants were significantly attracted to cities having more than 50,000 persons, and the same-sized cities had significantly fewer labor intensive ones. This was primarily because capital intensive national firms tended to choose locations in larger cities, particularly those with more than 50,000 persons, as did state firms, although not as significantly. High and low value-added plants also exhibited significant settlement-size biases. Places having more than 25,000 inhabitants and especially the larger-sized cities attracted more high value-added plants. Settlements with population sizes between 10,000-25,000 and fewer than 2,500 attracted fewer high value-added plants. This was again primarily because high value-added national firms were significantly attracted to the largest cities and low value-added ones were underrepresented there.

High wage plants were also significantly attracted to settlements with more than 25,000 persons. Small settlements and rural areas with populations less than 2,500 persons were significantly deficient in the number of high wage plants they attracted. However, no significant settlement-size bias by wage rate was found to exist when state-, national-, and foreign-based firms were considered separately. But it is fairly conclusive that large settlements, regardless of their regional location, attracted a disproportionate share of the new plants that were high wage, high value-added, capital intensive establishments.

## PLANT LOCATION AND ECONOMIC WELFARE

A few locational factors emerged from the analysis to help account for the state's low manufacturing wage level. First, the analysis revealed that it was the growth of the North Carolina-based firms that was most responsible for maintaining the traditional nature of the state's manufacturing structure and that it was the U.S. firms and especially the foreign firms that were less likely to contribute to the maintenance of this structure. In fact, chi-square analysis revealed that the non-North Carolina-based plants were significantly more high wage paying and capital intensive than North Carolina-based plants and that foreign-based plants were significantly higher value-added than could be expected on the average.

Second, the locational distribution of new plants tended to balance inequalities between the state's regions with the Coastal Plain (and particularly the Tidewater) gaining at the expense of the Piedmont. The Mountain region remained about the same—considerably poorer than the other regions. Since 60 percent of the previously existing plants were located in the Piedmont and only 23 percent in the Coastal Plain, the locational distribution of new plants represented a substantial shift between regions. The shift occurred because the Piedmont was a labor deficient area during the period while the Coastal Plain had an abundance of surplus labor: largely unemployed or underemployed farm laborers.[5] The fact that the Piedmont attracted small-sized plants while the Coastal Plain attracted the larger ones likewise attests to the different levels of unemployment in each region. The Mountain region, even though characterized by high unemployment, had a sparse labor force, not easily accessible to manufacturing plants.

Third, the capital intensive, high value-added, high wage plants were attracted to large settlements because of the localization and urbanization economies required by these establishments. Such economies, exemplified by higher-skilled workers, specialized services, and better transportation and communication linkages, are only to be found in large towns and cities. The considerably greater number of low wage, low value-added, labor intensive plants, not requiring these economies, were attracted to the small towns and rural areas that provided lower-cost surplus labor and land.

Finally, some researchers have argued that the state's low manufacturing wage is primarily a result of its traditional industrial mix and partly a result of the low degree of trade unionization among its manufacturing workers. Others have found that wage rates for identical jobs, regardless of the region of the country in which they are located, are directly related to settlement size (Fuchs 1967 and Hoover 1975, pp. 170-71). That is, the smaller the settlement size, the lower will be the wage rate for any particular job. Since the growth of new industry in North Carolina was predominantly the same low wage, low value-added, labor intensive type that dominated its manufacturing structure in the past and since this new industry predominantly located in the smaller settlements of the state, it can be argued that it is these factors that are significantly related to the state's low economic welfare level.

Pearson product-moment correlation analysis tends to support this conclusion (Table 2). In the states for which data were available, average hourly manufacturing wage rates were significantly related to the percentage of industrial plants that were capital intensive (r = .80).[6] The wage rate was also significantly related (but inversely) to the percentage of firms located in small settlements (r = -.59) so that the greater the number of plants located in small towns and rural areas, the lower was the wage rate. The percentage of unionized workers, however, was not significantly correlated with wage rates. Of interest also was the significant inverse relationships between the percentage of plants located in small settlements and both the percentage of unionized workers (r = -.73) and the percentage of capital intensive plants (r = -.72). The relationships suggest that union membership is likely to be much lower in smaller places as is the number of capital intensive plants. The analysis supports the argument that, along with the state's traditional industry mix, it is the dominance of industry in smaller urban places and rural areas that is mainly responsible for the state's low manufacturing wage rate, and not the low level of unionization. The same conclusion can be applied to many other Southern states since the region's nonmetropolitan labor markets have been growing at a faster rate than its metropolitan labor markets for some time now (Cramer 1963; Goodstein 1970; Marshall 1972; and Till 1973). Consequently, it is the supply of low-skilled surplus labor in small towns and rural areas that is the primary reason for the poorer economic well-being of the state.

Table 2—CORRELATION ANALYSIS OF SOUTHERN WAGE RATES

| | Rural and Small Town Plants | Capital Intensive Plants | Unionized Workers |
|---|---|---|---|
| Wage Rate | -.59<br>(.038) | .80<br>(.003) | .53<br>(.057)NS |
| Rural and Small Town Plants | | -.72<br>(.009) | .73<br>(.008) |
| Capital Intensive Plants | | | .41<br>(.116)NS |

*PLANT LOCATION POLICIES AND PROGRAMS*

In its economic development efforts North Carolina has been guided by two policies. One is to encourage the growth of more diversified, capital intensive, higher wage-paying industry in the state; and the other is to locate industry in the state's labor surplus areas. The first policy not only is directed to improving the state's overall wage level, but high value-added and capital intensive industries are necessary to generate future economic growth. This is because they tend to be fast growing whereas the state's present industry mix continues to be dominated by slow-growing manufacturing types. In slow-growing manufacturing types the potential for improvement in labor productivity, and thus the wage level, is highly limited. The second policy is directed toward reducing the rate of population outmigration from economically depressed areas of high unemployment. Population outmigration results in the loss of the more productive members of the area's labor force. It results in the loss of tax revenues and overall personal income needed to maintain public service programs and private business activity. It also results in the loss of the area's influence brought about by the reapportionment of political districts.

Policies require the implementation of programs for their objectives to be achieved. The state's "Governor's Award-Town Program" is designed to locate industrial plants in settlements of less than 15,000 persons, many of which are in labor surplus areas. The program encourages small settlements throughout the state voluntarily to fulfill specific requirements that will make them more attractive for industry. While it is difficult to separate the effects of this program from Federal programs that tend to reinforce its objectives, the results of this investigation showing the substantial growth of labor intensive industry in small settlements, especially in labor surplus areas, suggest that it has enjoyed some measure of success.[7] On the other hand, no specific program exists which selectively encourages the growth of high value-added or capital intensive industry in the state other than what occurs from promotional efforts to encourage the growth of industry in general. The overall decline in the percentage of such plants locating in North Carolina during the recent past attests to the need for such a program even though these efforts may have resulted in an overall increase in the percentage of high wage-paying plants.

The significant growth of high value-added, capital intensive, high wage industry in the state's large towns and cities found in this research suggests that a Governor's "Award-City Program" should be created further to promote this growth. Such a program could be developed, along with appropriate legislative action, to encourage larger-sized urban places to fulfill voluntarily a set of prescribed requirements designed to improve their urbanization and localization economies. The particular improvements recommended should be those that will make the larger places more attractive locations for selected industry types.

This is not to say that promotional efforts should be directed exclusively to attracting capital intensive, high wage industry since increasing the number of labor intensive, low wage industries in areas of high unemployment both increases the area's average wage level and overall level of economic well-being. Also, as the area's labor surplus becomes depleted, average wage levels tend to rise as the demand for labor increases. Additionally, a large segment of the state's labor force lacks the skills required by capital intensive firms.

## *CONCLUSION*

It may be argued that industrial development programs, unless they are designed to reinforce national and regional industrial location trends, have a limited effect on the growth of different types of industry in an area. Numerous studies suggest that it is the locational decisions of manufacturers responding to industrial location and regional development principles within a competitive market economy that are more important (Garrett 1968; Schriver 1971; and Bradfield 1976). In adherence to these principles, it is the substantial difference that exists between the North and South in labor costs that has made the South a more attractive location for labor intensive industries. Such industries may need to pay higher accessibility costs because of their Southern location, but the lower labor costs are more than sufficient to offset these additional costs. And it is the small towns and rural areas of the South, with their surplus labor forces, that provide the lowest labor costs of all.

But, as more and more labor intensive industry locates in the South, and its overall wage level increases relative to the rest of the nation, the region's demand for intermediate and consumer goods expands. As it expands, the region becomes more attractive for the location of high value-added and capital intensive industry, primarily those whose accessibility costs are a major portion of the total cost of doing business. Other "footloose" high value-added and capital intensive industries, those in which neither labor nor accessibility costs outweigh each other, may locate in the region to take advantage of its natural environment amenities, or better linkages to specific energy or material suppliers or markets. High value-added and capital intensive industries, notably those specializing in the production of intermediate products for sale to other manufacturers, tend to locate in or adjacent to larger urban settlements. In this way they are able to take advantage of a large number of specialized labor, business, financial, legal, repair, transportation, communication, public, and other required services at a lower cost than if they were to locate in small towns and rural areas, which are greatly limited in their ability to provide such services.

As a result of the regional development trends, more and more high value-added and capital intensive industries, notably those specializing in the production South. Since industrial growth takes place by the location of new or expanding industry more than by the relocation of existing industry, the real competition for these plants, then, is not between the North and the South but between the different Southern states. Those that are able to provide the business and labor climate and economic development programs which can furnish the urbanization and localization economies to high value-added, capital intensive, and high wage industry will have a locational advantage over the others and a better chance of improving their level of economic well-being.

## NOTES

1. For examples of spatial analysis techniques, see Berry and Marble 1968; Moriarty 1972, 1973, and 1974.
2. National wage rate and value-added data by industry were compiled from United States Department of Commerce 1974. For a more detailed description of this classification method, see Till 1973.
3. 1969 data were compiled from United States Department of Commerce 1971.

4. Since plants located in rural areas are often addressed to post office boxes in the nearest town or city, the percentage of small town and rural plants is greater than cited here.
5. In North Carolina the rural farm population was reduced by half during the decade 1960-1970, falling from 14 to 7 percent of the state's population.
6. The analysis was based upon data that existed only for Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.
7. The most important Federal government programs for industrial development purposes are those funded by the Small Business Administration (Local Development Company Loan Program), the Economic Development Administration (Business Development Assistance Program and Public Works and Development Facilities Program), and the Farmer's Home Administration (Business and Industrial Loan Program and Community Facilities Program).

## *REFERENCES CITED*

Batra, Raveendra and Gerald W. Scully. "Technical Progress, Economic Growth, and the North-South Wage Differential." *Journal of Regional Science* 12 (1972) :375-86.

Berry, Brian J.L. and Duane F. Marble, eds. *Spatial Analysis: A Reader in Statistical Geography*. Englewood Cliffs: Prentice-Hall, 1968.

Bradfield, Michael. "Necessary and Sufficient Conditions to Explain Equilibrium Regional Wage Differentials." *Journal of Regional Science* 16 (1976) :247-55.

Cramer, Douglas B. *Changing Location of Manufacturing Employment*. New York: National Industrial Conference Board, 1963.

Fuchs, Victor R. "Hourly Earnings Differentials by Region and Size of City." *Monthly Labor Review* 90 (1967) :22-26.

Garrett, Martin A., Jr. "Growth in Manufacturing in the South, 1947-1958: A Study in Regional Industrial Development." *Southern Economic Journal* 34 (1968) :352-64.

Goodstein, Marvin E. "A Note on Urban and Nonurban Employment Growth in the South, 1940-1960." *Journal of Regional Science* 10 (1970) :397-401.

Hartshorn, Truman A. "Prologue to Manufacturing in the South." *Southeastern Geographer* 14 (1974) :63-66.

Hoover, Edgar M. *An Introduction to Regional Economics*. 2nd ed. New York: Alfred A. Knopf. 1975.

Lonsdale, Richard E. "Rural Labor as an Attraction for Industry." *American Industrial Development Council Journal* 4 (1969) :11-17.

Lonsdale, Richard E. and Clyde E. Browning, "Rural-Urban Locational Preferences of Southern Manufacturers." *Annals of the Association of American Geographers* 61 (1971): 255-68.

Malizia, Emil E. "The Earnings of North Carolina Workers." *News Letter* (Chapel Hill: University of North Carolina, Institute for Research in Social Science) 60 (1975) :1-4.

Marshall, F. Ray. "Some Rural Economic Development Problems in the South." *American Economic Review* 62 (1972) :209-11.

McGregor, John R. "Water as a Factor in the Location of Industry in the Southeast." *Southeastern Geographer* 10 (1970) :41-54.

Moriarty, Barry M. "Locational Preferences and Urban Residential Development." *Proceedings of the Association of American Geographers* 4 (1972) :76-80.

______. "Causal Inference and the Problem of Nonorthogonal Variables." *Geographical Analysis* 5 (1973) :55-61.

______. "Socioeconomic Status and Residential Locational Choice." *Environment and Behavior* 6 (1974) :448-69.

Moriarty, Barry M. "Population and Employment Shifts Within Regional Hierarchies of Cities." *Proceedings of the Association of American Geographers* 7 (1975) :155-59.

_____. "The Distributed Lag Between Metropolitan-Area Employment and Population Growth." *Journal of Regional Science* 16 (1976a) :195-212.

_____. "Urban Population and Economic Growth: A Test of Alternative Theories." *International Geography: General Economic Geography* 6 (1976b) :315-19.

North Carolina, Economic Development Division. *North Carolina Directory of Manufacturing Firms: 1974-1975.* Raleigh: North Carolina Department of Natural and Economic Resources, 1975.

Schriver, William R. "The Industrialization of the South Since 1950." *American Journal of Economics and Sociology* 30 (1971) :47-69.

Scully, Gerald M. "The North-South Manufacturing Wage Differential, 1869-1919." *Journal of Regional Science* 11 (1971) :235-52.

Till, Thomas. "The Extent of Industrialization in Southern Nonmetro Labor Markets in the 1960's" *Journal of Regional Science* 13 (1973) :453-61.

United States Department of Commerce. *North Carolina County Business Patterns: 1969.* Washington, D.C.: U.S. Government Printing Office, 1971.

_____. *Census of Manufacturers: 1972.* Washington, D.C.: U.S. Government Printing Office, 1974.

Wheeler, James O. "Regional Manufacturing Structure in the Southeastern United States." *Southeastern Geographer* 14 (1974) :67-83.

_____. "Studies of Manufacturing Location in the South." *Geographical Review* 65 (1975): 270-72.

# *Research Frontiers in Applied Social Geography*

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Social geography's emergence and growth in North America are attributed to the identification of and focus on social problems in the mid-1960s. The geographers who studied geographical problems in a social context and social problems in a spatial context included a mixed group of cultural, economic, resource, medical, recreational, political, behavioral, transportation, and urban geographers. Their backgrounds varied as did their techniques and methodology. It is safe to state that the studies on society in general and social problems in particular were rare before 1965. This does not mean that social geography did not exist but rather that investigations were carried out under the rubric of other systematic areas of the discipline. Many of those research efforts carried out within the past ten to fifteen years may be considered applied in the sense that they identified contemporary problems and contained some practical or utilitarian purposes. In this context an applied theme is already an underlying current of social geography and its subfields.

The major objective of this paper is to identify a number of promising research directions in applied social geography. But, first, it seems in order to provide succinct definitions of social geography and of applied social geography. These are followed by a brief expository literature review that identifies some of the salient social geography research in the past decade. This survey represents a logical departure from which to suggest a number of further avenues for research.

## *DEFINITIONS*

Social geography is that segment of the discipline that treats the social interactive processes operating in a spatial context and the consequences of those behaviors as reflected in spatial patterns of one form or another. The processes or behaviors may be identified by and associated with individuals, groups, or institutions, such as businesses, churches, governments, or voluntary associations that contain or find some expression in a social context. The key to a social geography study is that its conceptual and structural framework can be identified with individual or group behavior and with the patterns evident as a result of those interactions. In this regard social geographers find research on racial and ethnic groups, different religions, urban redevelopers, city councils, and college students just as much a part of their field as spatial expressions evident in voting responses, magazine subscriptions, environmental perception, physician trips, public facility location, and "retired" migration to amenity areas. The emphasis on location or spatial components in either of the processes examined or the resulting pattern is what distinguishes social geography from those interfacing areas in sociology, political science, communications, landscape architecture, and ecological or behavioral psychology.

Applied social geography may include almost any study dealing with contemporary society or social problems. Conceptual and quantitative models of human behavior, decision-making networks, or multivariate pattern analyses as well as studies on water pollution, crime, zoning, or housing could be considered applied. In this discussion "applied" is used to indicate research that is concerned with an immediate problem and the implementation of policy making or recommendation. According to this definition, theoretical structures per se on metropolitan governmental reorganization or shopping-trip behavior affected by mass transit systems are excluded as are those that utilize simulations or factor analyses to examine the social geography changes in an area. The major criteria adopted in defining applied social geography efforts are that they be addressed to a problem facing society and that policy-making mechanisms be emphasized in some manner.

## APPLIED SOCIAL GEOGRAPHY 1977: A FOUNDATION

The notes, articles, discussion papers, reports, monographs, books, theses, dissertations, and other social geography literature that appeared in the past fifteen years number several thousand. The field has focused on the identification, measurement, and significance of spatial patterns and processes. A number of individuals and groups spearheaded the development of social geography. Special sessions, rump sessions, caucases, and radical groups meeting at regional and annual meetings helped to promote social geography as a distinct segment of human geography. The Detroit Geographical Expedition and Institute, the publication of *Antipode: A Journal of Radical Geography*, and the founding of SERGE (Socially and Ecologically Responsible Geography) stimulated research. Research topics included ethnic and racial groups; diseases; stepwise and channelized migration; social, shopping, physician, and worship trips; church locations; school redistricting; urban renewal; the recruiting of athletes; allocation of government resources; criminal activities; mental maps and cognitive structuring; time budgeting; hazard perception; and nonpartisan referendums. All of these fall under the broad heading of social geography. Investigations utilized household interviews, student perceptions, hospital data, employment trips, census data, and a variety of public records. Techniques included open-ended questionnaires, thematic apperception tests, and semantic differentials as well as simulations, scenarios, location-allocation models, and factor analyses. In sum, there has been a wide variety of research interests using a number of techniques and data sets at different scales. It is apparent that this diversity exists, but consideration of the total development of social geography and a review of methodological developments are not the purpose of this paper. There are a number of major research threads in applied social geography that can be identified. Some of the major representative works are cited here; however, many additional geographical references can be found in *Geo-Abstracts, Current Geographical Publications, Council of Planning Librarians Exchange Bibliographies,* and the theses and dissertations listed annually in *The Professional Geographer.* Because social geography is developing so rapidly, it is important to observe closely methodological statements, new topics investigated, and new techniques.

A number of books and statements on social geography have appeared in the last five years. Some have dealt with an overview of social geography (Eyles 1974) while others are on contemporary social issues (Albaum 1973). Books of readings containing articles on various themes (Palm and Lanegran 1973; Jones 1975) are more numerous than specific texts (Jakle, Brunn, and Roseman 1976). Some authors have placed social geography within the larger framework of human geography (Morrill 1974; Buttimer 1974) and urban geography (Pahl 1970; Berry 1971; Herbert 1973).

Books, monographs, and articles also provide a basis for further research within the various subfields of social geography. In medical geography the research directions have been identified in edited works by Hunter (1974) and Pyle (1976). Specific studies have concentrated on hospitals (de Vise 1973), physicians (Lankford 1974), patients (Earickson 1970), and the general delivery system (Shannon and Dever 1974). Wolpert (1976) in his presidential address to the Association of American Geographers emphasizes the need for studies concerned with groups traditionally excluded from social planning. Articles discussing access to public facilities and the development of location-allocation models have been published by *Antipode* (1971), Massam (1974), Cox et al. (1974), and Hillsman (1976). Political geography has developed foci on conflict (Cox 1973), federal outlays (Browning 1973), the organization and administration of space (Soja 1971; Massam 1972), the politics of the United States (Brunn 1974), and oceans (Prescott 1975). Transportation geographers, traditionally concerned with economic models and problems, have been studying social topics (Wheeler 1975, 1976).

Certain themes within social geography have been the thrust of research. These include behavioral models (Cox and Golledge 1967), cognitive structuring (Gould and White 1974), and diffusion (Brown 1974, 1975). Specific studies include blacks (Rose 1971; *Southeastern Geographer* 1971; *Economic Geography* 1972; Rose and McConnell 1972; Ley 1974; Davis and Donaldson 1975; Ernst and Hugg 1976), crime and justice (Harries 1974; Pyle 1974), poverty and social welfare (Morrill and Wohlenberg 1971; Peet 1972; Harvey 1973; Smith 1973; Wohlenberg 1976ab), and natural hazards (White 1974; Sims and Baumann 1974). Some studies treat interrelated problems, such as school assignment, busing, and housing (Lord forthcoming); natural disasters and reconstruction efforts (Foster 1976; Mitchell 1976); social conflict and land use (Horvath 1974); the assorted housing and transportation problems facing the elderly (Golant 1972; Stutz 1976; Wiseman 1977); political power strategies and spatial organization (Morrill 1973, 1976; Kasperson and Breitbart 1974); law and land use decisions (Platt 1975, 1977); and community power and social conflict (Wolpert et al. 1972; Ley 1973). Other types of studies, though fewer in number, include those articles on time-space budgets in Holly (1976), visual blight by Lewis et al. (1973), athletic recruiting and sports (Rooney 1969, 1974), urban territories (Ley and Cybriwsky 1974), urban structure (Muller 1975 and Bourne 1976), and the urban physical environments (Detweyler and Marcus 1972). The study of information sources and fields (Gould 1975; Palm 1976) and their contribution to understanding society (Zelinsky 1974) merit further study. We need not restrict research to solving contemporary problems because the future offers a vast array that also merits examination (Abler 1975).

## *RESEARCH FRONTIERS*

Applied social geography research can be used to alleviate problems that exist or may arise in a number of areas. Those which involve geographical concepts are the chief concern. Recommendations for study may be derived from at least two sources: first, that a social geographical examination of an issue or problem is appropriate and, second, that spatial components become an integral part of any recommendation to policy boards or decision makers. These are slightly different but not completely separate approaches. Geographers with applied interests would be wise to continue research in both areas. It would be equally advantageous from a public policy standpoint if geographers would utilize their technique and methodolgy training to develop specific solutions with spatial processes, dimensions, or components in mind. This applies just as much to the location of new airports, the reorganization of school districts, and the delivery of health services to the elderly as to the allocation of public funds for mass transit and recreation in metropolitan areas.

Application of social geography concepts, techniques, and methodologies to contemporary problems need not be restricted to the public sector. Decisions regarding medical care, public transportation, and vital social services are important to society. Social policies are made by mayors, council members, legislators, and governors as well as school boards, police agencies, airport authorities, and recreation planners. Many officials are involved in the organization of space, where to place facilities, and how to allocate dollars and personnel. Leaders in businesses, industries, and institutions such as real estate developers, church administrators, hospital boards, and community groups daily make policies that affect the geography of cities and rural areas. Deciding where to build new shopping centers or low-income housing, consolidate churches, close old schools, or request zoning changes all affect the circulation, interaction, and attitudes of communities. Finding improved ways to organize or reorganize space or to provide a better allocation of human resources, such as doctors, lawyers, police, or teachers, and financial resources, including grants and loans, or to locate public and private facilities may be examples of applied social geography. Ten research frontiers that are offered as profitable lines for research in applied social geography are identified below. Each one identifies a number of possible topics for investigation. The ten, although separate, are not considered as being mutually exclusive. Few contemporary social problems can be easily categorized into distinct areas of study. The ten areas are (1) location of public and private facilities, (2) organization and reorganization of space, (3) delivery of services, (4) allocation of resources, (5) spatial disparities, (6) social behavior, (7) environmental awareness, (8) time-space issues, (9) obsolescent and recycled spaces, and (10) future society.

1. *Location of public and private facilities.* This area includes studies on the location of schools, day-care centers, police precinct stations, hospitals, churches, airports, and parks. There is a need to examine why these functions, installations, and facilities are located where they are and what role political and social forces have in the proposals considered and adopted. Social geographers are in an excellent position to recommend locations for these and other facilities with their knowledge and understanding of spatial and social processes occurring in either urban or rural areas. Studies of this nature would do well to devise and recommend a series of spatial decision-making models that incorporate the possible locations vis-à-vis variations in community attitudes, environmental constraints, and political power distribution. Social geographers need to examine where these facilities or institutions are or might be and to propose location-allocation models. In developing such studies, it is important to consider the effects these facilities have on community spirit, compatible land use planning, land values, and nearby environmental settings. The spillover effects of an amenity such as a park or swimming pool or church would be much different than placement of sanitary landfills, prisons, high power transmission lines, underground nuclear waste-disposal sites, airports, or X-rated movie houses.

2. *Organization and reorganization of space.* At a rudimentary level the organization may involve regionalization methods and strategies. Whether using qualitative or multivariate quantitative measures, social geographers may propose a series of models—cartographic, descriptive, and statistical—for ways to organize space. The opportunities for research in this area are considerable because local and state governments, the federal government, labor unions, school boards, church denominations, professional groups, and voluntary associations all have devised ways to divide space. Possibilities for research also exist in the interna-

tional arena, to organize ocean spaces or propose international regions to resolve existing and potential problems. The strategies used in these regionalizing schemes may be based on realistic assumptions and meaningful parameters for contemporary society; however, they also may have remained intact as social and economic conditions changed. Retaining a similar organizational framework today as fifty or thirty years ago may be unwieldy, expensive, and inefficient to maintain. Populations change in distribution, numbers, life styles, as do their attitudes toward institutions. In such cases geographers can contribute to reorganization efforts. They may study consolidation of school districts in rural areas or in urban parochial systems, student migration across state lines for graduate training to promote interstate financing for specialized programs, multicounty efforts for jails or public health services, reapportionment of congressional districts, or the elimination of impractical administrative systems for churches, professional groups, or voluntary associations. Research might also be undertaken on county consolidation and the formation of regional planning units or the reduction of the number of different state and federal agencies and divisions that have different and overlapping regions. Efforts could be carried out under the assumption that with reorganization a more effective administration could operate if similar programs were coordinated and standardized regions were used. The benefits would result in better service to the public or private group at possibly reduced cost and greater efficiency.

3. *Delivery of services.* Social geographers are encouraged to continue their efforts along these lines as they are useful contributions to public agencies and private groups. Investigating the accessibility of the public to physicians, hospitals, outpatient mental-health centers, genetic counseling centers, recreation areas, libraries, and schools are as useful as are studies investigating the optimal location of food-stamp centers, day-care centers, senior-citizen centers, unemployment offices, polling places, and post offices. Providing an efficient and equitable delivery system for any health, welfare, or education service is closely tied to the location of those facilities. Studies that focus on the accessibility of various age groups to public services have merit—for example, preschoolers to day-care centers, grade-school youths to swimming pools and baseball lots, and elderly to libraries, hospitals, public transit, and outdoor recreation areas. Proposing a series of solutions with various location-allocation models can be useful in planning.

4. *Allocation of resources.* This heading refers to the amounts and flows of financial and human resources provided for solving problems or assigning individuals to specific areas. What are the supply-demand ratios in a geographical context for physicians, social workers, the clergy, lawyers, and environmental administrators? What kinds of geographical disparities are evident from mapping the existing needs and the resources (human or financial) available withing a city, state, or nation? What do the flows of public dollars for environmental, health, education, housing, and legal programs reveal about the demands at given locations? Are

there readily discernible differences in the amounts that are awarded certain cities or states indicating that noneconomic (political) forces may explain the variations? Are all Sunbelt states receiving larger shares of government revenues for all federal programs or only some and, if so, which ones? Are funds directly related to population growth? Studies on the allocation or placement of human resources such as educational, medical, clerical, legal, and administrative merit further research as do those on the amount, direction, and flows of dollars for hospitals, schools, churches, parks, and programs including mass transit, urban renewal, environmental cleanup, antipoverty, and senior citizens. The possibilities for research can be extended internationally to assess the geographical dimensions of aid by governments to disaster areas, by international agencies such as World Bank, by religious bodies such as the Church World Service, by private groups such as the Red Cross, or by multinational corporations such as Exxon. Geographical models, including those that are cartographic, schematic, or quantitative, could be developed to help in our understanding of how they operate.

Another possible topic for investigation in the allocation of human resources is the recruitment issue. Universities select presidents; departments do the same for faculty and graduates as do coaches for athletes and businesses for managers. What are the spatial variables considered in the search for talent? How strong and important are territorial and extraterritorial "fields" in the search-and-selection process by professional organizations, private groups, and the federal government? To what extent are territorial or academic loyalty and education and experience in similar "environments" critical in the selection, advancement, and geographic transfer of individuals?

5. *Spatial disparities.* For lack of a better term, the research possibilities in this area concern inequalities and inequities in society. While spatial variations have been noted in some areas already listed, the focus here is on major social issues that need investigating. These include more in-depth investigations into poverty, environmental quality, social conflict, hunger, racial and age discrimination, drugs and alcohol, violence in the home, variations in criminal laws, and judicial sentencing. Studies might also be pursued on the territorial behavior of juvenile gangs, organized crime networks, redlining effects, black suburbanization efforts, and urban homesteading schemes. The disparities in housing, employment, education, health care, and recreation need to be studied for such groups as blacks, Indians, Orientals, and Chicanos, but also for adolescents, the physically and mentally handicapped or impaired, single adults, the divorced, and the elderly.

6. *Social behavior.* The need for research is for continued analysis of the variations in attitudes, identities, and behaviors of individuals and social groups. The efforts completed to date on work and social trips (vacation, church, and personal visits) and even the journey to death (accident fatalities) have provided a good beginning for the methodologies that might be used to study other forms

of behavior. The effects of busing on schoolchildren's identification of communities merit study. The distance the public needs to travel to vote may influence whether or not that privilege is exercised; deciding the maximum distances voters are willing to walk or drive to vote may lead to a relocation of polling stations. How citizens perceive levels of crime in a city would be worth comparing with the data available. Are there different kinds of crime trips that exist for the different types of crimes? What kinds of environments do criminals select for different types of crimes? How do the feelings of territoriality change in areas where new population groups enter or new commercial developments appear? What feelings of identity do highly mobile and professional persons have? How can the stresses, fears, and frustrations of many immobile individuals and groups be alleviated in parts of cities or rural areas where rapid social change or economic development is occurring? What changes are institutions undergoing to meet the needs of a changing society? How are inner city and suburban schools, churches, and youth/adult organizations identifying with their communities and constituents? Are the institutions speaking to the needs of their new clientele (race, age, or social class), or are they becoming isolated or insulated from the changes going on around them? What programs are schools, churches, governments, planning agencies, and downtown developers addressing themselves to in the areas where they own property or where they serve? The collection and use of survey data to analyze the social environments and problems begun in the past decade provide a good framework for studying some of the above questions.

7. *Environmental awareness.* Additional studies that may be carried out are on hazard perception, environmental perception, environmental preservation, and environmental quality. Studies on how individuals perceive natural or human disasters, such as hurricanes, floods, droughts, dust storms, ice storms, heavy snows, and earthquakes are needed as are those that consider how people perceive the environments in which they live, work, and play. Studying how and why residents perceive in the ways they do their areas and the people, institutions, and natural features in them will help us to understand their attitudes toward the environment and environmental issues. How voting results on environmental issues, whether building airports and parks or recommending no growth and providing greater consumer protection, relate to socioeconomic measures may help us to understand the consumer/environmental views that more and more people share. Referendums also aid in assessing the degree of interest and commitment the public and decision makers (individuals or governing bodies) have regarding the protection and preservation of the environment. Concern for the environment is also expressed in various nuclear power issues that are raised; this involves locating environmentally "safe" areas for nuclear power development, transporting radioactive materials on routes other than through densely populated areas, and securing safe burials for waste materials. Environmental awareness encompasses other concerns including the protection of beaches and lakes from oil well blowouts or tanker spills and the protection of endangered species and unique areas of natural

or geologic beauty from the noise of supersonic aircraft and recreation vehicles, from industrial pollution and smog, and from theft and vandalism. Public policy now must take into account the human/physical interfaces in making decisions on how spaces will be used, developed, or preserved.

8. *Time-space issues.* Geographers with their interest in space can provide meaningful information regarding how people use and budget their time. Studies reveal that present and changing life styles have distinct spatial and temporal patterns and can be used to plan and locate such facilities as shopping centers, parks, schools, employment nodes, and public transportation. Surveys will help answer how and for what purposes different groups use their time during the day, week, month, and year or decade. These findings may also be useful in the allocation of resources and the planning of the delivery of services. Other time-budgeting studies are needed to determine how the allocation of time for activities and space needs for those activities changes throughout one's lifetime. Studies of this nature might be applied to different income, education, age, and racial/ethnic groups within society to see what their travel, correspondence, and communication networks and patterns are. For example, to know how the elderly communicate and travel, with whom and how frequently, may help both in identifying and selecting the kinds of services they need and in planning retirement homes or neighborhood centers. Time-space studies of another nature could involve measuring the effects of "future shock," which may stem from information overload, social conflict, or rapidly changing values. The diagnosis of this condition is that an individual concludes that too much change is occurring too fast, relationships are transitory and temporary, and impermanence replaces permanence. The physical and mental symptoms of shock are felt by many young, middle-aged, and old. It would be worthwhile for social geographers to test for the degrees of "future shock" in a city or neighborhood undergoing rapid transition or in a static condition to find out the reasons for it (possibly through the use of the semantic differential test) and how individuals cope with it—possibly through withdrawal; through excessive use of drugs, alcohol, sex; or through religious zealousness. Solutions might involve planning neighborhood activities and centers to establish increased personal contact, improving the esthetics of the environment, having social workers or physicians readily available, establishing answering services to "help" agencies, televising craft or hobby programs, or promoting a network of counseling centers where individuals can freely come or telephone anonymously for assistance. Organizations attempting to halt immoderate consumption of drugs and alcohol are examples that operate in a social system. Other ways to alleviate the stresses that result from neighborhood rejuvenation or long-distance moving may be to make the elements of the commercial landscapes similar. This "geography of sameness" is a scheme promoted and successfully adopted by national motel and hamburger chains.

9. *Obsolescent and recycled spaces.* These studies are concerned with obsolete buildings in cities and abandoned and vacant lands that could be used for better

purposes. Countless facilities are being abandoned because of changes in population, society, and technology. These include schools, churches, meeting halls, and railroad depots and tracks, highways, filling stations, general stores, and sometimes entire villages and hamlets. In some cases entire central parts of cities are obsolescent and in need of recycling. While many of these physical structures remain in a derelict state, others have been converted into new uses: homes, antique shops, and boutiques from the buildings and bike paths, snowmobile trails, and wildlife sanctuaries from railroad rights of way. It may help us to understand future organization and planning by analyzing the rate, scale, and processes by which abandonment takes place. This would call for mapping and analyzing the spatial ramifications of metropolitan or rural obsolescence. In urban areas there are often large areas of abandoned, decrepit, and ugly apartments, hotels, warehouses, and apartment complexes. Changes in use can be seen in defunct shopping centers or military bases being used for amusement parks, vocational training centers, or cultural exhibit/teaching purposes. Old colleges are becoming conference centers, hotels, hospitals, and artist colonies. New uses can be found for vacant lands and obsolescent buildings within the inner city. Gasoline filling stations have become banks, laundries, and fast-service minimarts. Some downtown churches that closed because their parishioners moved to the suburbs have been resold to denominations which attract new generations of migrants (blacks or Puerto Ricans or Chicanos). The transition zone around central business districts has numerous examples of decayed houses that have been razed for used-car lots, restaurants that became rummage stores, and pool halls that were converted to adult book stores or storefront missions. Urban planners need to consider both the kinds of land use changes taking place, their rate of change and locational attributes. In an area where commercial, industrial, or residential expansion is costly, it may be cheaper to recycle existing buildings than to build new ones. Two examples in urban areas illustrate this point. One need is to satisfy the acute demand for recreation lands in downtown areas by developing rooftop recreation areas and by opening up green spaces such as cemeteries for walks and picnics. In some cities cemeteries are rather scenic and often contain unique habitats for rare plants and birds. The recreational part of life is recognized as vital to one's physical and mental health, and the provision of such facilities for inner-city residents (usually long distances from public parks) may require some innovative planning schemes. The second example also focuses on the recreation/entertainment needs and could be applied to inner-city or suburban areas. This calls for closing some streets to vehicular traffic and using them for community dances and neighborhood activities. Streets, instead of serving as machine spaces, might even be torn up and turned into attractive areas for picnics, gardens, hiking, and biking. Such changes as these reflect a perception of space and how much importance we place on private transportation needs over environmental aesthetics. Such reuse planning efforts may be quite realistic in the future.

10. *Future society.* Studies on the contemporary scene are needed as are those that investigate the social conditions and processes operating twenty-five or fifty years from now. These studies may show the kinds of effective social planning that might be carried out once the spatial dimensions and processes are recognized. Several possible avenues for research are given here. There is a group of studies that may be considered under the heading of "zero population growth." A society with a static population, not an unlikely situation by the middle of the next century, will have different characteristics including more people older than sixty-five and fewer children. There will be less demand for larger cars, larger houses, elementary schools, and baby and youth industries. There will be requests for increased social legislation; new middle-aged and aging life styles will emerge; and politicians will increasingly seek the "gray" vote. Overall college enrollments will probably decline; some colleges will close or be forced to consolidate undergraduate and graduate programs; multiple career opportunities will be pursued; and earlier retirement will be common. Some of these changes in society are already evident in television commercials for drugs and cosmetics, the building of condominiums, and the impact of retirement-oriented industries and communities. A zero-population state may be accompanied by a progression towards a no-growth economy. This will mean that the distribution of people, jobs, energy, houses, and services will become a critical element in regional or national planning. How the population shifts to Sunbelt states and amenity environments will be closely monitored. There will be a need for developing geographical models to use in studying a steady-state economy and population, to determine how much energy is needed, what to do with wastes, how many cars or residential units are needed, how much classroom space is required, where to locate a given number of educators, planners, physicians, or social workers. Adjusting to a zero-growth or no-growth society has fascinating social and geographical dimensions that merit serious study. Quality control may replace quantity production as the chief goal in industries. The values, life styles, attitudes, and behaviors of society in general and specific groups also need to be considered. Will consumer/environmental attitudes continue to be important in locating controversial yet critical energy, transportation, recreation, and housing developments? Will there be new ethics developing in a postindustrial society that will replace those agrarian and industrial ones so widespread today? How will governments, organizations, and institutions respond to the changes in society, both at a national and regional level but also on a world scale? The social geography of the world will be different at 2001 and 2050 from the present. The critical question that geographers might ask is if they can use their spatial perspective on events and processes and their cartographic, field, remote-sensing, and quantitative-computer techniques to alleviate the problems of social conflict, maldistribution of food and energy, overpopulation, technology and resource gaps, environmental destruction, and geopolitical jealousies. This would be a challenge and noble goal well worth our serious consideration.

## SUMMARY

Social geography developed rapidly in the 1960s in North America as a segment of the discipline concerned with contemporary social problems and their solutions. The contributions to date are many and represent a solid base for building a stronger body of knowledge in applied social geography. Applied emphases involve directing our talents and research efforts to the solutions of problems. Students and professionals should utilize their geographic techniques and skills to develop strategies, models, and conceptual designs that can be incorporated into public policy and administrative decisions. Applied studies may also call for some redirection in our training and methodological orientation. To assist in the solution of contemporary social problems by incorporating geographical concepts and methodology is the kind of contribution that may provide personal and professional pride and growth. This is a goal we as geographers might aspire to in our continued study of social problems. The rewards that come make the efforts worth the while.

## REFERENCES CITED

Abler, R. et al. *Human Geography in a Shrinking World.* North Scituate, Mass.: Duxbury, 1975.

Albaum, M., ed. *Geography and Contemporary Issues: Studies of Relevant Problems.* New York: Wiley, 1973.

*Antipode* 3 (1971), entire issue on "Access to Essential Public Services."

Berry, B. J. L., ed. "Comparative Factorial Ecology." *Economic Geography* 47 (June 1971 Supplement).

Bourne, L. S. "Urban Structure and Land Use Decisions." *Annals of the Association of American Geographers* 66 (1976) :531-47.

Brown, L. A., ed. "Studies in Spatial Diffusion Processes: Empirical." *Economic Geography* 50 (1974) :285-374.

______. "Studies in Spatial Diffusion Processes: Conceptual." *Economic Geography* 51 (1975) :185-304.

Browning, C. E. *The Geography of Federal Outlays.* Studies in Geography no. 4. Chapel Hill, N. C.: University of North Carolina, Department of Geography, 1973.

Brunn, S. D. *Geography and Politics in America.* New York: Harper and Row, 1974.

Buttimer, A. *Values in Geography.* Commission on College Geography Resource Paper 24. Washington, D. C.: Association of American Geographers, 1974.

Cox, K. R. *Conflict, Power and Politics in the City: A Geographic View.* New York: McGraw-Hill, 1973.

Cox K. R. and R. College, eds. *Behavioral Problems in Geography.* Studies in Geography no. 17. Evanston, Ill.: Northwestern University, Department of Geography, 1967.

Cox, K. R., D. R. Reynolds, and S. Rokkan, eds. *Locational Approaches to Power and Conflict.* New York: Halstead Press, 1974.

Davis, G. A. and O. F. Donaldson. *Blacks in the United States: A Geographic Perspective.* Boston: Houghton-Mifflin, 1975.

de Vise, P. *Misused and Misplaced Hospitals: A Locational Analysis of the Urban Health Care Crisis.* Commission on College Geography Resource Paper 22. Washington, D. C.: Association of American Geographers, 1973.

Detweyler, T. R. and M. G. Marcus. *Urbanization and Environment.* North Scituate, Mass.: Duxbury, 1972.

Earickson, R. *The Spatial Behavior of Hospital Patients.* Research Paper 124. Chicago: University of Chicago, Department of Geography, 1970.

*Economic Geography* 48 (1972) :1-134, entire issue on "Contributions to an Understanding of Black America."

Ernst, R. T. and L. Hugg, eds. *Black America: Geographic Perspectives.* Garden City, N. Y.: Anchor/Doubleday, 1976.

Eyles, J. D. "Social Theory and Social Geography." In C. Board et al., eds., *Progress in Geography,* vol. 6, pp. 27-87. London: Edward Arnold, 1974.

Foster, H. D. "Assessing Disaster Magnitude: A Social Science Approach." *The Professional Geographer* 28 (1976) :241-47.

Golant, S. M. *The Residential Location and Spatial Behavior of the Elderly: A Canadian Example.* Research Paper 143. Chicago: University of Chicago, Department of Geography, 1972.

Gould, P. "Acquiring Spatial Information." *Economic Geography* 51 (1975) :87-99.

Gould, P. and R. White. *Mental Maps.* Baltimore: Penguin, 1974.

Harries, K. D. *The Geography of Crime and Justice.* New York: McGraw-Hill, 1974.

Harvey, D. *Social Justice and the City.* Baltimore: Johns Hopkins Press, 1973.

Herbert, D. T. *Urban Geography: A Social Perspective.* New York: Praeger, 1973.

Hillsman, E. "Solving Public Service Location Problems." *Proceedings of the Association of American Geographers* 8 (1976) :143-45.

Holly, B. *Time-Space Budgets and Urban Research: A Symposium.* Research Paper 1. Kent, Ohio: Kent State University, Department of Geography, 1976.

Horvath, R. J. "Machine Space." *The Geographical Review* 64 (1974) :167-88.

Hunter, J. M., ed. *The Geography of Health and Disease.* Studies in Geography no. 6. Chapel Hill, N. C.: University of North Carolina, Department of Geography, 1974.

Jakle, J. A., S. D. Brunn, and C. C. Roseman. *Human Spatial Behavior: A Social Geography.* North Scituate, Mass.: Duxbury, 1975.

Jones, E. *Readings in Social Geography.* New York: Oxford, 1975.

Kasperson, R. and M. Breitbart. *Participation, Decentralization, and Advocacy Planning.* Commission on College Geography Resouce Paper 25. Washington, D. C.: Association of American Geographers, 1974.

Lankford, P. M. "Physician Location Factors and Public Policy." *Economic Geography* 50 (1974) :244-55.

Lewis, P. F., D. Lowenthal, and Y. Tuan. *Visual Blight in America.* Commission on College Geography Resource Paper 23. Washington, D. C.: Association of American Geographers, 1973.

Ley, D., ed. *Community Participation and the Spatial Order of the City.* Vancouver: Tantulus Research Limited, 1973.

———. *The Black Inner City as Frontier Outpost: Images and Behavior of a Philadelphia Neighborhood.* Monograph Series 7. Washington, D. C.: Association of American Geographers, 1974.

Ley, D. and R. Cybriwsky. "Urban Grafitti as Territorial Markers." *Annals of the Association of American Geographers* 64 (1974) :491-505.

Lord, J. D. *Spaital Perspectives on School Desegregation and Busing.* Washington, D. C.: Association of American Geographers, forthcoming.

Massam, B. H. *The Spatial Structure of Administrative Systems.* Commission on College Geography Resource Paper 12. Washington, D. C.: Association of American Geographers, 1972.

———. "Political Geography and the Provision of Public Services." In C. Board et al., eds., *Progress in Geography,* vol. 6, pp. 179-210. London: Edward Arnold, 1974.

Mitchell, W. A. "Reconstruction After Disaster: The Gediz Earthquake of 1970." *The Geographical Review* 66 (1976) :296-313.

Morrill, R. "Ideal and Reality in Reapportionment." *Annals of the Association of American Geographers* 63 (1973) :463-77.

———. *The Spatial Organization of Society.* North Scituate, Mass.: Duxbury, 1974.

———. "Redistricting Revisited." *Annals of the Association of American Geographers* 66 (1976) :548-56.

Morrill, R. and E. L. Wohlenberg. *The Geography of Poverty in the United States.* New York: McGraw-Hill, 1971.

Muller, P. O. *The Outer City.* Resource Paper 75-2. Washington, D. C.: Association of American Geographers, 1975.

Pahl, R. E. *Patterns of Urban Life.* London: Longmans, 1970.

Palm, R. "Real Estate Agents and Geographical Information." *The Geographical Review* 66 (1976) :266-80.

Palm, R. and D. A. Lanegran, eds. *An Invitation to Geography.* New York: Wiley, 1973.

Peet, R., ed. *Geographical Perspectives on American Poverty.* Monographs in Social Geography no. 1. Worcester, Mass.: Antipode Publications, 1972.

Platt, R. H. *Land Use Control: Interface of Law and Geography.* Resource Paper 75-1. Washington, D. C.: Association of American Geographers, 1975.

———. "The Loss of Farmland: Evolution of Public Response." *The Geographical Review* 67 (1977) :93-101.

Prescott, J. V. R. *The Political Geography of the Oceans.* North Pomfret, Vt.: David and Charles, 1975.

Pyle, G. F. et al. *The Spatial Dynamics of Crime.* Research Paper 159. Chicago: University of Chicago, Department of Geography, 1974.

———, ed. "Human Health Problems: Spatial Perspectives." *Economic Geography* 52 (1976): 95-191.

Rooney, J. F., Jr. "Up from the Mines and out from the Prairies: Some Geographical Implications of Football in the United States." *The Geographical Review* 59 (1969) :471-92.

———. *A Geography of American Sport: From Cabin Creek to Anaheim.* Reading, Mass.: Addison-Wesley, 1974.

Rose, H. M. *The Black Ghetto: A Spatial Behavioral Perspective.* New York: McGraw-Hill, 1971.

Rose, H. M. and H. McConnell, eds. *Perspectives in Geography 2: Geography of the Ghetto: Perceptions, Problems and Alternatives.* DeKalb, Ill.: Northern Illinois University Press, 1972.

Shannon, G. and G. E. A. Dever. *Health Care Delivery: Spatial Perspectives.* New York: McGraw-Hill, 1974.

Sims, J. H. and D. D. Baumann, eds. *Human Behavior and the Environment: Interfaces Between Man and His Physical World.* Chicago: Maaroufa Press, 1974.

Smith, D. M. *The Geography of Social Well-Being in the United States: An Introduction to Territorial Social Indicators.* New York: McGraw-Hill, 1973.

Soja, E. *The Political Organization of Space.* Commission on College Geography Resource Paper 8. Washington, D. C.: Association of American Geographers, 1971.

*Southeatern Geographer* 11 (1971):85-168, entire issue on "Geographic Aspects of Black American."

Stutz, F. P. "Adjustment and Mobility of Elderly Poor amid Downtown Renewal." *The Geographical Review* 66 (1976) :391-400.

Wheeler, J. O., ed. "Transportation Geography: Societal and Policy Perspectives." *Economic Geography* 49 (1975) :95-184.

———. "Transportation Geography." *Southeastern Geographer* 16 (1976) :1-81.

White, G. F, ed. *Natural Hazards: Local, National, Global.* New York: Oxford, 1974.

Wiseman, R. F. and M. Virden. "Spatial and Social Dimensions of Intraurban Elderly Migration." *Economic Geography* 53 (1977) :1-13.

Wohlenberg, E. H. "Interstate Variations in AFDC Programs." *Economic Geography* 52 (1976) :254-66.

——. "Public Assistance Effectiveness by States." *Annals of the Association of American Geographers* 66 (1976) :440-50.

Wolpert, J. et al. *Metropolitan Neighborhoods: Participation and Conflict over Change.* Commission on College Geography Resource Paper 16. Washington, D. C.: Association of American Geographers, 1972.

——. "Opening Closed Spaces." *Annals of the Association of American Geographers* 66 (1976) :1-13.

Zelinsky, W. "Selfward Bound? Personal Preference Patterns and the Changing Map of American Society." *Economic Geography* 50 (1974) :144-79.

# *Redlining: A Concept for Study by Urban-Social Geographers*

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Redlining has become a highly controversial issue in recent years as neighborhood groups in various cities organize to combat the practice. Probably the strongest of these is the National People's Action on Housing, organized in 1972 in Chicago (Taggart 1974, pp. 14-16). The organization grew out of an incident in Chicago in 1971, in which two potential borrowers were denied loans by a local lender due to the *location* of the properties. Neighborhood awareness of the problems of financing grew as the National People's Action on Housing disseminated information to neighborhoods. Finally the Illinois Legislature and the Governor acted on the problem by conducting an eighteen-month investigation and the passage of legislation prohibiting discrimination in lending by location. It also mandated disclosure of mortgage loan activity (Illinois 1975ab). Other neighborhood groups have been accorded similar action in certain cities of Wisconsin, Massachusetts, New York, California, and Minnesota (Wisconsin 1975; Office of Commissioner of Banks 1975; Superintendent of Banks 1976; California Business and Transportation Agency 1975; University of California, Berkeley 1975). In 1975 the actions of organized groups had an impact at the federal level as Congress passed the Home Mortgage Disclosure Act (U.S. Congress 1975). Although redlining is inherently a spatial problem, few geographers have studied it.

The purpose of this paper is twofold: (1) to examine the nature and consequences of redlining and (2) to determine the sources of data and the methodology needed to conduct an applied or empirical study of redlining. Once the data sources and the methodology have been described, some results of empirical studies of redlining will be presented.

## *THE CONCEPT OF REDLINING*

Redlining is a multifaceted concept with the behavior of mortgage lenders and geographic location as the unifying factors. There are minor and major forms of redlining. Among the minor forms of redlining are the following: (1) the requiring of higher down payments than those usually necessary for comparable properties in other areas, (2) the requiring of loan maturities below the number of years to maturity set for comparable mortgages in other areas, and (3) the requiring of higher interest rates than those usually charged for financing comparable properties in other areas. Redlining in its major form involves the practice by mortgage lenders of denying loans on properties located in a specific geographic area. In both minor and major forms of redlining such behavior by mortgage lenders occurs without regard to the credit rating of the borrower or the quality of the specific property. Some authors have extended the concept to include not only geographic location but the arbitrary denials of financing based on racial and ethnic considerations or any consideration which is not justified on the basis of legitimate, demonstrable economic criteria (Francis et al. 1976a, p. 2; Agelasto and Listokin 1975, p. 1; Sledge 1976, p. 1).

Some neighborhood groups, in search of a more operational definition, have stated that a lending institution is practicing redlining if during a specified time period, perhaps one year, it made a lower percentage of total loans to a certain neighborhood than the percentage of the institution's total deposits which originate from that neighborhood (U.S. Department of Commerce 1976, p. 1). In other words, when a neighborhood's loans do not equal its deposits, it is being redlined.

The practice of denying loans for certain properties in a specific geographic area has been coined "redlining" because it is believed that lending officials draw a red line on a map around the borders of an area to indicate to the staff the location of properties on which real-estate loans are not to be made or else made at terms substantially less favorable than those available in other areas of the city (Fefferman 1976, p. 26). For example, loans may be made in the "redlined" areas only with larger down payments or at higher interest rates or for shorter terms than in other areas, or no loans may be made to the area on any terms. Some lending institutions may refuse to make loans in an area if most of the properties are above a certain age, say, thirty years. For example, if houses built before 1940 predominate in a certain area, the area could be considered ineligible for loans just as though it were redlined on a map (Nelson 1976, p. 6; University of California, Berkeley 1975, p. 1). Thus, customers for more recently built homes in the area suffer the same consequences of loan denial as buyers of older homes. The lender usually justifies his refusal to make a loan by citing the *location* of the collateral, not necessarily the collateral itself. Location is translated to mean demand, and demand is interpreted to mean the safety of the remaining loan balance in the event the borrower defaults. The lenders lump the good housing with the bad, the old with the more modern, and deny them both new mortgage credit (Rothenberg 1976, p. 32). As a result, those neighborhoods that are typically redlined tend to have the following characteristics: (1) older housing, though structurally well built; (2) middle-class or blue-collar income groups; (3) racially integrated, white ethnic, or black populations; and (4) location adjacent to poorer neighborhoods (U.S. Congress 1975).

## *REDLINING TECHNIQUES*

Redlining is very difficult to identify. The issue is one of access to mortgage financing, and the process of discouraging a potential borrower can be a very subtle one. Probably a large amount of redlining occurs without any record to indicate that there was a loan request. In other words, many potential borrowers are discouraged prior to submitting a written loan application.

There are several techniques used to discourage a potential borrower. One is the *high interest rate technique,* whereby the lending officer simply tells the potential borrower that the firm cannot compete with the interest rates of other lending institutions and suggests that the loan request be made elsewhere in the neighborhood. Or a very high interest rate may be quoted in order to discourage the submission of an application and at the same time leave the impression that the borrower is receiving a favor by being directed toward institutions with lower interest rates (Rothenberg 1976, p. 24).

A second technique is the *age of housing technique.* The lending officer simply indicates that his institution will not finance housing older than, say, twenty years. This procedure is very effective in discouraging many potential borrowers who wish to buy property in central cities, particularly inner-city areas, because it is highly probable that the property they wish to buy is at least that old (Rothenberg 1976, p. 24).

A third technique is the *low maximum loan technique.* The potential borrower is told that the lending institution has a low maximum loan amount policy, which means that it cannot make mortgages above, for example, $35,000 when the potential borrower has requested a $45,000 loan. Thus, a higher down payment would be necessary.

A fourth technique is the *short-term mortgage technique.* The potential borrower is told that the lending institution is only making mortgages of, say, twenty-five years. The potential borrower, however, has requested a thirty-year loan.

A fifth technique is the *low-value technique.* The loan officer, for example, tells the potential borrower that the lending institution will not make a loan above 75 percent of value. This would require the potential borrower to provide at least 25 percent as a down payment.

These techniques effectively discourage many potential borrowers. By convincing the potential borrowers that the loan conditions are matters of policy and beyond the loan officer's authority, the officer is effectively removed from any responsibility, with the implication that the actual decisions are made elsewhere. The truth is that the "policy" may gave been created in order to discourage a potential borrower from formally applying for a loan on property interpreted to be located in a "high risk" or "hazardous" area.

### *The Origins of Redlining in American Cities*

Although organized neighborhood resistance to redlining is of recent origin, the practice itself is not. Redlining is probably as old as cities, capitalism, and the rent theory of value. An early capitalist lender may have perceived a risk to lending money on property located near a slaughterhouse, for example. Thus, loans may have been refused to those who wanted to buy property near that or any other slaughterhouse. Therefore, properties located near slaughterhouses were redlined because of the perception that, should the borrower default on the mortgage, the lender would incur a high risk of finding another buyer for the property since few people are willing to live near slaughterhouses (Sledge 1976, pp. 6, 7; Sternlieb 1966, p. 112). The practice of redlining in American cities can be traced back at least to the 1930s following the establishment of the Federal Home Loan Bank Board and similar organizations such as the Home Owners Loan Corporation. In 1940 the former organization provided statistics to mortgage lending institutions on various neighborhoods in American cities. It classified neighborhoods into "high risk" and "low risk" areas. The areas classified as "high risk" or ranked low were predominantly black (U.S. Commission on Civil Rights 1973). These were the areas in which loans were not to be made. The latter organization prepared a detailed survey and classification of mortgage credit risk areas in Oakland and Berkeley, California. Four classes were established, and each neighborhood was color coded on an accompanying map. Areas labeled "hazardous" were colored red. The purpose of the government-administered survey was to guide mortgage lenders in making loans in the cities. The primary criterion used to classify an area as "hazardous" for home loans was the proportion of "undesirable population," a synonym for "minority populations" (Home Owners Loan Corporation 1936).

As early as 1944 Swan warned of the consequences of redlining in New York City. He wrote that, if the policies of lenders refusing to provide credit to certain areas were allowed to continue, an entire city could gradually be effectively prevented from receiving new loans (Swan 1944). More recent evidence indicates that several urban areas are experiencing serious difficulties obtaining new mortgage money (Sternlieb 1972). It appears, then, that the *old* practice of denying loans to certain *areas* within the city has become policy with some lending institutions (Daniel 1975, pp. 441-44) The consequences are that the entire city eventually suffers as the stages in the redlining process lead to greater and greater deterioration.

### *Stages in the Redlining Process*

The redlining process consists of nine stages. The early stages (one to three) are subtle and go largely undetected. However, the impact of the succeeding stages is much more severe. The following are characteristic of the redlining process:

Stage 1. Higher down payments on mortgages are required.
Stage 2. Higher interest rates on loans are required.
Stage 3. Shorter loan maturities are given.
Stage 4. Older houses are denied mortgage loans altogether. Homeowners are forced to borrow from mortgage banking firms who obtain their funds from out-of-town insurance companies or pension funds. As housing deteriorates in one area, the remainder of the neighborhood soon follows in a self-perpetuating cycle of decay (Institute for Policy Studies 1975, p. 1).
Stage 5. Home improvement loans are denied in the area. This often leads to poor maintenance and eventually to the occurrence of slum conditions and housing abandonment (Mazin 1974).
Stage 6. Conditions worsen and property insurance is denied or is provided only at exorbitant rates. Neighborhood businesses, already suffering from a lack of credit, begin to leave, taking essential services and important sources of cash flow out of the neighborhood. People are forced to shop out of the neighborhood, leaving less and less of a market for the remaining businesses (National Urban League 1971).
Stage 7. Property values in the redlined neighborhood continue to decrease but at an accelerated rate. Loans or insurance of any kind are difficult to obtain. The few remaining young middle-class families migrate from the area, leaving behind the poor and the aged.
Stage 8. The declining property values in the redlined neighborhood are financially felt by the entire city as revenue declines while the demand for social services increases. Redlining spreads to other neighborhoods (Sternlieb and Burchell 1973).
Stage 9. In this final stage the entire city is drained of so much revenue because of redlining that the quality and quantity of essential services are reduced as the tax rate of the city is substantially increased. Loans within the entire city are either denied or difficult to obtain.

## *THE URBAN-SOCIAL GEOGRAPHER AND THE STUDY OF REDLINING*

Mortgage lending does not occur uniformly across city neighborhoods. Instead, it varies spatially. Mortgage loans are difficult to obtain in some neighborhoods and easy to obtain in others. Thus, mortgage lending is, in part, a function of geography. Heretofore, the importance of the discipline to an understanding of mortgage lending has not been demonstrated. Geography is so important in mortgage lending that, in assessing the value of property, the appraiser emphasizes the geographical location even to the point that a poorly built, aging structure in a growing, highly desirable neighborhood would have lending priority over a newly built structure in an economically declining neighborhood (Rothenberg 1976, p. 31).

In studying redlining, the geographer has a twofold task: (1) to determine the spatial pattern of mortgage lending in a selected city and (2) to explain why such a pattern exists. The application of geographic methods requires the correct formulation of the research problem, the selection of appropriate variables, gathering the appropriate data, mapping the variables, measuring the relationship between variables, and presenting conclusions.

### *Formulating the Research Problem*

As indicated previously, redlining is a multifaceted problem. The geographer may wish to study only one or all of the following aspects:

1. The denial of mortgage loans on the basis of location
2. The denial of home improvement loans on the basis of location
3. The establishment of loan to value ratios on the basis of location
4. The establishment of maximum loan terms on the basis of location
5. The denial of property insurance coverage on the basis of location
6. Differential purchase of mortgages by secondary market agencies on the basis of location
7. The denial of mortgage insurance on the basis of location

A research problem may be formulated to study any one of the seven aspects. The following example is appropriate: "The problem of this study is to determine the factors related to the spatial variation of (1) mortgage loans in city X or (2) home improvement loans or (3) loan to value ratios or (4) maximum loan terms or (5) property insurance coverage or (6) differential purchase of mortgages by secondary market agencies or (7) mortgage insurance."

### *Discussion of the Research Problem*

Community groups have argued that lenders refuse to make mortgage or home improvement loans to certain areas solely on "perceived risk" which is unfounded in reality. Where spatial variation in lending activity has been documented, lenders state that to make loans in certain areas would be so risky as to constitute an unsound economic practice. Proving actual risk is difficult or impossible since inadequate data exist on default and foreclosure rates by location (Francis et al. 1976a, p. 13). Given the available data (which will be discussed later), the most that the geographer can do is to determine the spatial pattern of mortgage loans and explain why it exists.

The difficulty of measuring risk is also encountered in establishing loan to value ratios. Raising or lowering the ratio is a matter of lenders' discretion. Community groups argue that, in their efforts to protect themselves from "perceived risk," lenders erect unreasonable and discriminatory barriers to potential borrowers in certain areas. For example, a low loan to value ratio requires a higher down payment. When spatial variation in loan to value ratio has been documented, the lenders defend it on the grounds that a low loan to value ratio gives them a greater assurance that the borrower will not default. The lender can also draw upon empirical research to defend his position. At least one study has specifically indicated that the loan to value ratio is *the* single most significant variable in predicting default (Furstenberg 1970, p. 443). Data on the establishment of loan to value ratios and maximum loan terms by lending institutions are not easy to obtain. Thus, the geographer anticipating such research should prepare for a difficult task.

Lenders issue or deny property and mortgage insurance coverage on the basis of the same underwriting criteria they use for extending or denying a mortgage (Francis et al. 1976a, p. 14). Property insurance rates do in fact vary by the geographic location of the structure. In certain areas regarded as "high risk," insurance agents may refuse to extend coverage to any property regardless of its individual quality. Certain community groups have labeled such a consideration of neighborhood factors as discriminatory.

The Federal National Mortgage Association (FNMA) and the Federal Home Loan Mortgage Corporation (FHLMC) do, in fact, refuse to purchase loans in certain areas. The areas experiencing the greatest refusals are (1) where Housing and Urban Development 235 default rates are high, resulting in boarded-up houses in the neighborhood even though the general area may have sound housing, and (2) where most financing is through Federal Housing Administration or Veterans Administration loans (Francis et al. 1976a, p. 13). The willingness or refusal by such secondary market agencies to purchase mortgage loans may be a factor in the determination of whether or not the borrower receives a loan.

### *Choosing the Appropriate Variables*

Based on previous empirical studies of redlining, the following dependent variables are the most useful in studying the process:

1. The average mortgage amount by census tract
2. Total dollars loaned by census tract
3. The number of mortgages issued by census tract

Studies also indicate that the following independent variables may provide the greatest utility in explaining the spatial variation in lending activity within an urban area by census tract:

1. Racial composition or, operationally, the black population as percentage of total population by census tract
2. Racial change or the percentage change in black population from years X to Y by census tract
3. Median family income by census tract
4. The homeownership rate or percentage of owner-occupied housing units by census tract
5. The percentage of housing units in one- to four-unit housing structures by census tract

6. Average household size by census tract
7. The percentage of vacant units by census tract
8. The relative age of housing by census tract
9. The value of housing by census tract
10. The structural quality of housing by census tract
11. The crime rate by census tract
12. The demand for mortgage loans, or operationally (a) the number of real estate transactions or (b) net change in the number of households by census tract

### *Gathering Appropriate Data*

Probably the largest obstacle facing the geographer studying redlining is accessibility to reliable data on which to document the process (White 1976, p. 3). The task can be somewhat facilitated if the sources of data necessary to conduct a study of redlining are clearly identified. The first and most important data are on mortgage lending activity by spatial unit; for example, neighborhood, Zip code, or census tract. The latter spatial unit is the most appropriate. Since the passage of the Home Mortgage Disclosure Act of 1975, geographers can request the following data from lending institutions:

1. The number and total dollar amount of mortgage loans originated or purchased by each financial institution in the preceding fiscal year by census tract for areas within a Standard Metropolitan Statistical Area (SMSA) and by Zip code for areas outside the SMSA
2. The number and total dollar amount of mortgage loans which are insured by the Federal Housing Administration and the Veterans Administration
3. The number and total dollar amount of mortgage loans made to a mortgagor who did not, at the time of execution of the mortgage, intend to reside in the property securing the mortgage
4. The number and total dollar amount of home improvement loans (U.S. Congress 1975, Section 304)

If the geographer wishes to supplement the preceding data or collect information on lending activity prior to 1976, he or she should consult either the county recorder of deeds of Lusk's Real Estate Directory for the area under study. The latter source lists each mortgage transaction for a given municipality on a weekly basis and provides the address and name of buyer, the date of transaction, the selling price, the mortgage amount, the name of the lender, and miscellaneous information. Depending on the geographer's choice of independent variables, most of the racial, social, and economic data necessary to explain the spatial variation in mortgage loans can be obtained from the latest United States Census Statistics, Polk's City Directory, or local crime statistics for the area under study.

### *Mapping the Variables*

After gathering the data, the geographer should map the spatial pattern of the dependent and independent variables. This may reveal spatial relationships between the dependent and independent variables.

### *Measuring the Relationship Between Variables*

The most effective technique for measuring the relationship between variables is multiple regression analysis. The typical model used in most empirical studies has been a log linear functional form based upon a multiplicative relationship between the variables. The effect that a change in one independent variable has on mortgage lending is therefore dependent upon the level of the other variables.

### *Findings of Selected Empirical Studies*

There are many studies on redlining; however, very few are empirical (U.S. Department of Housing and Urban Development 1976; Agelasto and Listokin 1975; Kollias 1976). Empirical studies have been conducted on redlining in Baltimore, New York, Philadelphia, Pittsburgh, Washington, D.C., Los Angeles, and Flint, Michigan.

The Baltimore Department of Housing and Community Development Home Ownership Program(n.d.) used 1970, 1971, and 1972 data from Lusk's Maryland Real Estate Guide for Baltimore and Baltimore County and 1970 census data. It focused on mortgage lending patterns by census tract for different types of institutional lenders. The conclusions were that the center of the city received fewer conventional single-family home loans.

Divine et al. (1974) analyzed mortgage lending in nineteen planning districts in the Bronx section of New York City. By analyzing the overall record of twelve institutional lenders between 1960 and 1970, the authors demonstrated a general pattern among them of reducing the share of their loans allocated to the Bronx. The authors also determined, through the use of regression analysis, what variables accounted for the spatial variations in mortgage lending activity among the nineteen planning districts in the Bronx. The independent variables used were the proportion of nonwhites in a district, the proportion of one- to four-family structures in a district, and median rent in the district. The authors concluded that race had no significant impact in 1960 on either the number or the value of mortgages in the Bronx. However, race had become a significant factor in mortgage lending by 1970.

The Northwest Community Housing Association (1973) compared mortgage lending in two similar neighborhoods, that is, northwest Philadelphia and northeast Philadelphia. The neighborhoods differed only in terms of race. The authors found that lending volume declined over time in northwest Philadelphia where the black population increased but remained relatively stable in northeast Philadelphia. The authors concluded that racial discrimination in the spatial distribution of lending does exist and can be identified because the variation in lending in the two neighborhoods was due to racial changes.

On the other hand, the factor of race was not a significant variable in explaining mortgage lending in Pittsburgh. The Pittsburgh study was based on the number of mortgage loans made and the total number of residential real estate transactions which occurred during the period 1973 and 1974 in sixty-five Pittsburgh neighborhoods. The data on loans were obtained from the County Registrar of Deeds. Additional data were gathered on median family income, the percentage of vacant units, the homeownership rate, the crime rate, black population as a percentage of total population, and the percentage change in black population from 1960 to 1970. Multiple regression analysis was used to specify the variables which were statistically significant in explaining mortgage lending variation in the city. The results were that the following variables are statistically significant: (1) percentage of vacant units, (2) median family income, (3) crime rate, and (4) the number of residential real estate transactions. The percentage of vacant units is negatively related to the number of mortgages; as vacancies increase, mortgage financing decreases. The median family income is positively related to mortgage loans; the higher the median income, the higher the number of loans received. Crime rates are negatively related to the number of mortgages. The number of residential real estate transactions is a proxy for the demand for mortgage loans. It is positively related to the number of loans made to a neighborhood. The following variables are not statistically significant, according to the study of redlining in Pittsburgh: (1) percentage of homeownership, (2) black population as a percentage of total population, and (3) the percentage change in black population from 1960 to 1970 (Ahlbrandt 1975, pp. 10-11). Caution is advised, however, in interpreting the results of the Pittsburgh study, for two reasons. First, the study did not analyze data on mortgage amounts. Thus, we do not know the effect that differences in mortgage size may have had on the spatial variation in lending. Second, the study did not separate governmentally insured mortgages from conventional mortgages (Ahlbrandt 1975, p. 13). Thus, some neighborhoods may have been denied conventional mortgages and instead received only FHA and VA insured mortgages.

The study of redlining in Washington, D. C. has been conducted by the Institute for Policy Studies (1975). Data on the total number of loans, the volume of loans, and the average loan size were obtained from Lusk's Real Estate Directory for 1972 to 1974. Additional data were gathered on the following: (1) the percentage of owner-occupied housing units, (2) the percentage of housing units in one- to four-unit housing structures, (3) the average household size, (4) median family income, (5) percentage black, and (6) total population for each census tract. The results were that loans were not evenly distributed throughout the city. Instead, the spatial pattern was as follows: (1) 69 percent of the city's population received only 36 percent of the total loan volume, (2) 28 percent of the city's population received only 8 percent of the total loan volume, (3) 14 percent of the city's population received 40 percent of the loan volume, and (4) 3 percent of the city's population received 16 percent of the total loan volume. The authors concluded, by simply comparing areas, that such variation in loan volume was a function of differences in the racial composition of the Washington, D. C. area. The area that received only 36 percent of the total loan volume but had 69 percent of the city's population was 88 percent black. The area that received only 8 percent of the total loan volume but had 28 percent of the city's population was 92 percent black. The area receiving 40 percent of the total loan volume but had only 14 percent of the city's population was 97 percent white, and the area receiving 16 percent of the total loan volume but had only 3 percent of the city's population was also 97 percent white. A major limitation of the Washington, D. C. study is that the authors did not distinguish between residential and commercial loans or loans made for first mortgages vis-à-vis rehabilitation or refinancing.

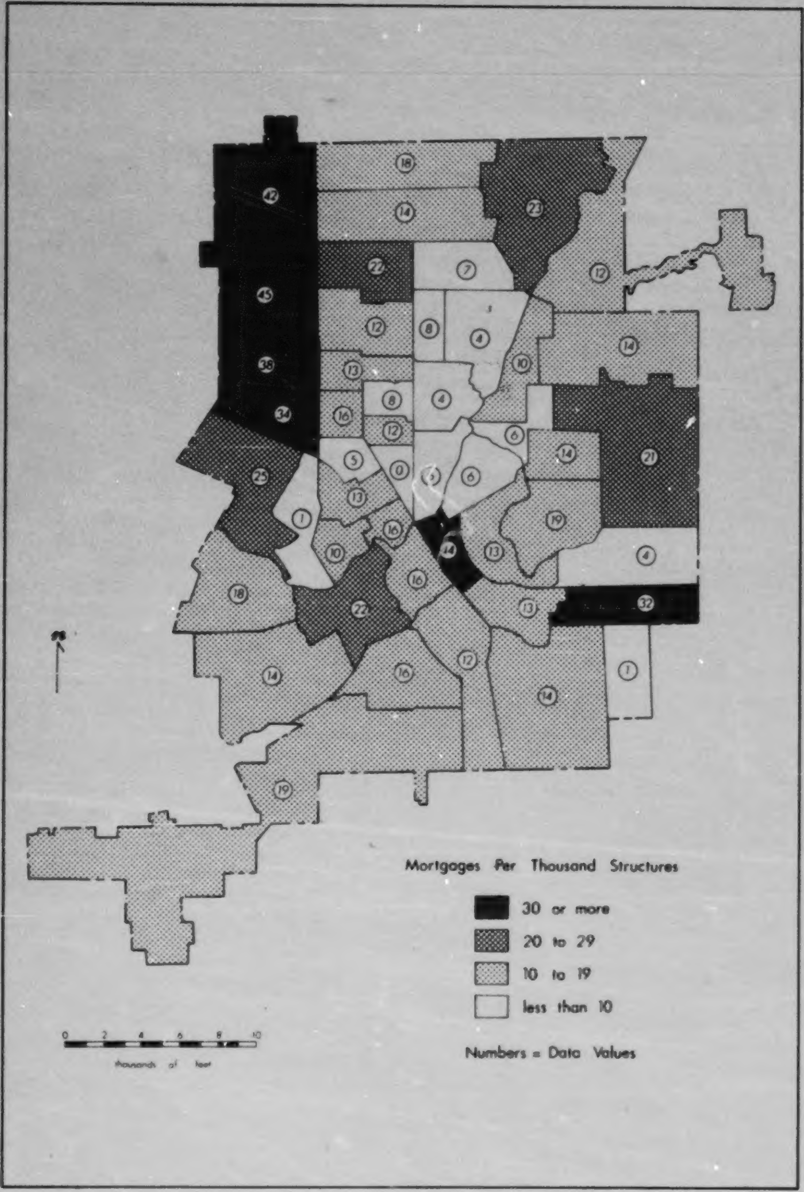
Redlining in Los Angeles has been examined by the Center for New Corporate Priorities (1975). Using simple comparative illustrations on mortgage loan availability and the characteristics of census tracts, the authors demonstrated the relationship between the number of loans, interest rate or down payment, and the characteristics of census tracts such as median income, percent black, or percent Spanish origin. Each discussion of an area was followed by an explanation of the observed mortgage lending patterns in terms of income, race, and related factors. The authors concluded that Los Angeles County's poor, black, and Spanish-origin neighborhoods were deficient in the receipt of mortgage loans which was due to simple racism on the part of mortgage lenders.

Redlining in Flint, Michigan, has been examined by the Governor's Task Force on Redlining headed by Richard J. Francis (1976b). The study examined the amounts and location of 1,000 mortgage loans granted in Flint between January 1975 and June 1976 as reported in the weekly *Legal News*. Additional data were collected on neighborhood racial composition, relative age, housing value, owner occupant mobility, and income. Two measures of racial composition were used, namely, percentage black by census tract in 1970 according to the U.S. Census and percentage black in 1975 by census tract according to a survey conducted by the Evidence for Community Health Organization (ECHO). Data on the percentage black at two different time periods allowed for an assessment of the effect of racial change on mortgage lending. Racial change was defined as the difference between the percentage black in 1975 and in 1970. The relative age of housing was derived from census data on the percentage of residential units built prior to 1940, during 1940, and during 1950. Housing value and owner occupancy data were based on a 100 percent survey conducted by ECHO on the structural condition of the housing stock of Flint by census tracts. Unlike previous empirical studies, this study started with the premise that there are factors which should legitimately influence the spatial variation of mortgage lending and should therefore be controlled. These variables were (1) owner occupancy, a surrogate for demand; (2) income, a surrogate for creditworthiness; and (3) value and structural condition of homes in a neighborhood, a surrogate for collateral. After controlling for such variables which denote "sound lending practices," multiple regression analysis was employed. The results were as follows: (1) the average mortgage issued in predominantly black census tracts was significantly lower than elsewhere; (2) predominantly black census tracts had fewer total dollars loaned, although the effect was not statistically significant; (3) predominantly black census tracts received fewer loans, although the effect was not statistically significant (Figures 1 and 2); (4) the average mortgage in racially changing tracts was significantly smaller than those for other areas; (5) racial change had no significant effect on total dollars loaned; (6) racially changing tracts received more loans than others, though the difference was not statistically significant; (7) areas of older housing and areas of newer housing received almost the same total dollars loaned, but areas of older housing received their dollars in a few large loans, while areas of newer housing received a larger number of moderate-sized loans.

## SUMMARY AND CONCLUSIONS

The review of empirical studies seems to confirm the following: (1) mortgage lending varies spatially in cities; (2) the spatial pattern tends to be directly or indirectly related to the racial composition, income, and the age of housing. Thus, predominantly nonwhite, low income areas of older housing receive fewer mortgage loans than other areas of cities.

More studies of redlining are needed, however, as disclosure legislation makes accessibility to data less difficult. The study of redlining is still in an early stage, and the geographer has much to contribute despite the fact that a complete understanding of the problem cannot be achieved given the present data. Previous studies were (and those in the near future will be) done at the aggregate level. Such studies have inherent limitations. They do not tell you who among the various applicants of an area was denied a loan and for what reason. Thus, it is not possible with aggregate studies to determine the true extent of discrimination in mortgage lending. The decision whether or not to issue a loan is a complicated one with no established consistent written standards, while the setting of the terms of a loan, such as rate period, down payment, and the like, is even more complex (Francis et al. 1976b, p. 52). Furthermore, the data on individual cases which are used by the lender are not accessible for use in research at the present time even with the passage of the Home Mortgage Disclosure Act of 1975 (U.S. Congress 1975). At a minimum, information is needed on the number of loans denied in a neighborhood and the reasons for denial (Francis et al. 1976a, p. 23). Such data are presently inaccessible. Nevertheless, redlining is, and will remain, a spatial problem, and for that reason alone it deserves to be studied by geographers.


18
14
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13
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16
19
10
44
13
4
18
16
22
13
32
14
12
16
14
1
19
N
Mortgages Per Thousand Structures
30 or more
20 to 29
10 to 19
less than 10
Numbers = Data Values
0
2
4
6
8
10
thousands of feet

Figure 1. The Spatial Pattern of Mortgages Issued per Thousand Residential Structures (Flint January 1975 to June 1976)

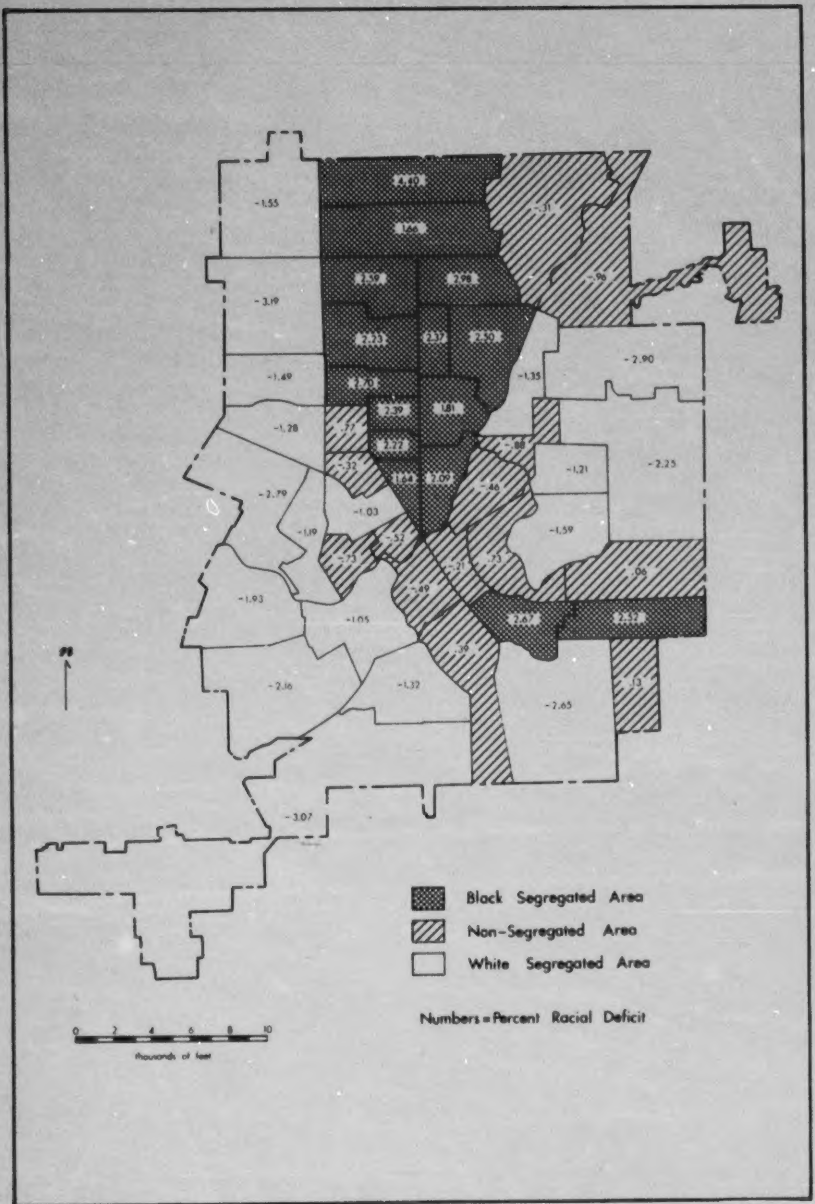
4.40
1.66
2.59
2.98
2.23
2.37
2.50
2.70
2.39
1.81
2.22
1.64
2.09
2.67
2.52
-1.55
-3.19
-1.49
-1.28
-2.79
-1.19
-1.03
-1.93
-1.05
-2.16
-1.32
-3.07
-.31
-.96
-1.35
-2.90
-.77
-.32
-.88
-1.21
-2.25
-.46
-1.59
-.52
-.73
-.21
.73
.06
-.49
.39
.13
-2.65
Black Segregated Area
Non-Segregated Area
White Segregated Area
Numbers = Percent Racial Deficit
0
2
4
6
8
10
thousands of feet

Figure 2. The Spatial Pattern of Black Residential Segregation (Flint 1970)

## *REFERENCES CITED*

Ahlbrandt, Roger S., Jr. *Mortgage Lending in Pittsburgh.* Action Housing, Incorporated. Public Policy Series Monograph no. 6, 1975.

Agelasto, Michael and David Listokin. *The Urban Financing Dilemma: Disinvestment, Redlining.* Exchange Bibliography no. 890. Monticello, Ill.: Council of Planning Librarians, 1975.

Baltimore Department of Housing and Community Development Home Ownership Development Program. *Home Ownership and the Baltimore Mortgage Market.* Baltimore, n.d.

California Business and Transportation Agency. *Administrative Code.* Title 10 No. 75-31 (November 1975).

Center for New Corporate Priorities. "Where the Money Is: Lending in Los Angeles Counties." In U.S. Congress, Senate Committee on Banking, Housing and Urban Affairs. *Home Mortgage Disclosure Act of 1975.* 2 parts. Hearings before the 94th Congress, first session on S. 1281, 1975.

Daniel, Edwin. "Redlining." *Journal of Housing* 32 (October 1975) :441-44.

Divine, Richard et al. *Where the Lender Looks First: A Case Study of Mortgage Disinvestment in Bronx County.* New York: The National Urban League, 1974.

Fefferman, Hilbert. *The Redlining of Neighborhoods by Mortgage Lending Institutions and When Can Be Done About It.* Federal National Mortgage Association Special Report, 1976.

Francis, Richard et al. *Interim Report of the Governor's Task Force on Redlining.* Michigan Department of Commerce, Financial Institutions Bureau Report, 1976a.

———. *Final Report of the Governor's Task Force on Redlining.* Michigan Department of Commerce, Financial Institutions Bureau Report, 1976b.

Furstenberg, George V. "The Investment Quality of Home Mortgages." *Journal of Risk and Insurance* 37 (September 1970) :437-45.

Home Owners Loan Corporation. *Mortgage Risk Areas in Oakland and Berkeley.* 1936.

Illinois. *Financial Institutions Disclosure Act.* Public Act 79-632 (1975a).

. *Illinois Fairness in Lending Act.* Public Act 7 9-634 (1975b).

Institute for Policy Studies. *Redlining: Mortgage Disinvestment in the District of Columbia.* Public Interest Group Report, 1975.

Kollias, Karen. *Neighborhood Reinvestment: An Annotated Bibliography.* Washington, D.C.: National Center for Urban Ethnic Affairs, 1976.

Mazin, George J. "The Impact of Credit Availability on Housing Abandonment: The Case of the Mid Bronx." Master's thesis, Cornell University, 1974.

National Urban League. *The National Survey of Housing Abandonment.* Urban League Report. New York, 1971.

Nelson, Gordon E. *Some Perspectives on Redlining.* Federal National Mortgage Association Special Report, 1976.

Northwest Community Housing Association. *Mortgage Disinvestment in Northwest Philadelphia.* Philadelphia, 1973.

Office of Commissioner of Banks. *Massachusetts Disclosure Directive.* Public Act No. 8260-9-555-7-75 (August 1975).

Rothenberg, Alan E. "The Impact of Real Estate Lending Biases on the Purchase and Rehabilitation of Older Urban Residences." Paper presented to Neighborhood Groups in California, 1976.

Sledge, Brenda H. "Redlining: Dysfunction of the Housing Market." Master's thesis, Michigan State University, Department of Urban Planning, 1976.

Sternlieb, George. *The Tenement Landlord.* New Brunswick, N. J.: Rutgers University Press, 1966.

______. *The Urban Housing Dilemma*. New York: Housing and Development Administration, 1972.

Sternlieb, George and Robert Burchell. *Residential Abandonment: The Tenement Landlord Revisited*. New Brunswick: Center for Urban Policy Research, 1973.

Superintendent of Banks. *Reports of Mortgage and Deposit Data by Banking Organizations*. Supervisory Procedure G 107 (February, 1976).

Swan, Herbert. *The Housing Market in New York City*. New York: Reinhold, 1944.

Taggart, Tee. "Redlining: How the Bankers Starve the Cities to Feed the Suburbs." *Planning* (December 1974) :14-16.

University of California, Berkeley. Center for Real Estate and Urban Economics. "Redlining." *Current Urban Land Topics* 1 (October 1975) :1-13.

U.S. Commission on Civil Rights. *Understanding Fair Housing*. A report of the Commission. Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Congress. Senate Committee on Banking, Housing and Urban Affairs. *Home Mortgage Disclosure Act of 1975*. 2 parts. Hearings before the 94th Congress, first session on S. 1281, 1975.

U.S. Department of Commerce, Financial Institutions Bureau. "The Problem of Neighborhood Redlining." Unpublished paper, January 1976.

U.S. Department of Housing and Urban Development, Library Division. *Redlining: A Bibliography*. Washington, D.C., 1976.

White, Anthony G. *Discrimination in Housing Loans—Redlining: A Selected Bibliography*. Exchange Bibliography no. 977. Monticello, Ill.: Council of Planning Librarians, 1976.

Wisconsin. Wisconsin Administration Code. Ch. S-L 27.05 (b) (2) (April 1975).

# *Applications of Medical Geography in the Developing World*

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Considering the emphasis that geography as a profession has traditionally placed on the interpretation of environmental relationships, it is remarkable what little attention has been paid to the critical role of disease in that process of adaptation. Although the subfield of medical geography has witnessed something of a revival within the last fifteen years, this has primarily reflected an increased desire to apply techniques of spatial analysis to problems of the location and delivery of health care; the number of studies concerned with problems of health and disease distribution in an environmental context is noticeably small.

## *MEDICINE AND THE DEVELOPING WORLD*

This neglect of environment-disease relationships is particularly curious because of geography's traditional concern with the developing world. Despite great efforts by international agencies, such as the World Health Organization, and by many national governments and private institutions, the developing world is still severely threatened by disease, especially the infectious ones. This is in sharp contrast to the situation in Western Europe and North America, where degenerative diseases are more dominant.

In temperate and colder areas most infections are derived from other humans, but in the tropics and subtropics many are arthropod-borne or are zoonoses derived from animal sources; in addition, there are a number of infections caused by free living organisms which are facultative parasites. Most developing countries are in nontemperate areas, and it is tempting to speculate if the importance of infectious disease plays any part in maintaining this situation.

The infective disease pattern of these countries is generally both complex and unstable. In addition to high and seemingly resistant rural levels of disease, often untouched by prophylactic measures, there has been a noticeable expansion, well documented since World War I, of new conditions for infection often intimately associated with the process of economic development.[1] Deforestation and the introduction of new forms of cultivation may have a pronounced effect on the distribution of arthropod vectors. For example, in the expansion of rubber plantations from the coastal plains into the foothill zones of Malaya, a critical and profitable development in the European exploitation of this country, planters were advised by the government to clear all vegetation from the stream banks on the estates in order to discourage the breeding of the traditional lowland malaria vector, *Anopheles umbrosus*—only to encourage inadvertently the fatal invasion of *Anopheles maculatus,* with its preferred breeding habits of swift, clear, and sunlit streams. The consequence was an unprecedented series of outbreaks of malaria among the estate laborers.[2]

Population movement, whether for traditional reasons such as trade and pilgrimage or for more contemporary purposes such as work on new irrigation or transport projects, may also play an important role in the transmission of diseases into new environments. This, for example, has been a factor in the spread of yaws among the migrants employed in a number of rural drainage projects in south Sumatra.[3] Yaws is extrememly contagious. There are records of whole villages contracting the disease within a very short period of time during the Japanese occupation in Malaya. It can be cured if treated early enough, but it is highly resistant to antibiotics in the later stages of infection. It provides a major public health control problem in many parts of Southeast Asia.

There are numerous other documented instances of the inadvertent spread of diseases to new environments in the developing world. The attendant increases in encephalitis and in schistosomiasis associated with irrigation projects and the epidemics of pulmonary tuberculosis and venereal disease in the crowded and rapidly expanding cities are but a few examples.[4]

Many developing countries suffer from both an overall low per capita income and an unequal distribution of wealth. Thus, not only is there low national expenditure on medical care and education, but it is particularly inadequate for the very poor, especially those in rural areas. Despite the publicized reforms of countries such as Tanzania in the organization and distribution of health services, most developing countries, either through inertia, impoverishment, or private interests, retain antiquated health care delivery structures concentrated in the cities and economically developed areas such as on mines and estates.[5] Lack of immunization, inadequate supplies and distribution of drugs, poor isolation facilities, and shortage of qualified medical staff may all contribute to low levels of health. Frequently there are substantial numbers of patients in infective stages moving at large within the population. Public health officials are generally well aware of the problems, but the provision of adequate health care is often so expensive as to be impractical.

Many of the infectious diseases of the developing world require constant surveillance to be controlled; and any disaster, such as drought, floods, or war, may have a far greater impact on the outbreak and spread of disease than in the temperate world. Restricted amounts of water can lead rapidly to contamination of supplies, with repercussions such as epidemics of cholera or typhoid; crowded conditions brought about by social upheavals may lead to typhus outbreaks; food shortages may have a critical effect on rates of infection among an already malnourished population. In the developing world the relationship between humans, environment, and disease is precariously balanced. Surely the discipline of geography has important contributions to make, both in increasing the knowledge of the transmission cycle of some of these diseases and in the planning of more effective control measures.

## *TRADITIONS OF GEOGRAPHY AND DISEASE*

The indifference of most contemporary geographers to the geography of disease is all the more surprising in that it is a relatively recent characteristic of the discipline. In the early nineteenth century, when most popular explanations of disease were based on "miasmatic theory,"[6] large numbers of colonials, both civil and military, diligently collected medico-geographical data in the process of administering their districts or trying to maintain their troops in a healthy condition. The miasmatic theory of disease was curiously imprecise regarding what peculiar combination of environmental circumstances might generate miasma. Thus, if knowledge was to continue to develop, comprehensive statistics on temperature, moisture, vegetation, soils, ventilation, aspect, cultivation, and even the obscurities of sol-lunar influence (registered through tide tables) were recorded and sometimes coordinated with the time of the onset of infection, as well as the numbers, sex, age, and race of those who suffered from ill health. In this way, nineteenth-century colonists were able to reach some admittedly very broad conclusions about the geography of health and disease in certain areas of the tropics. It was recognized that an effective means of escaping disease was to avoid certain environments, just as the most promising method of regaining one's health was a change of air and situation.

The art of interpreting the health of a place or a region was called medical topography; and its practitioners, who were generally doctors, were found throughout the regions of former colonial expansion, which now make up so much of the developing world. They insisted that the arts of medicine and geography were intimately connected. There is little evidence that any large-scale military or economic plans were abandoned on their advice, but they were undoubtedly responsible for the relative environmental caution with which the early nineteenth-century colonists treated their invasion and development of the tropical world and its inhabitants.

The emergence and gradual acceptance of germ theory towards the end of the nineteenth century helped to bring about the shift away from environmental explanations of disease toward a concern with the control and eventual elimination of disease-causing organisms or pathogens. Colonial administrators continued to maintain figures on morbidity and mortality but in a far more abbreviated fashion than previously. Trying to understand the environmental geography of a particular disease was largely abandoned, to be replaced by the most recent colonial medical service stress on vector eradication or control, immunization and prophylactic drug administration, and the development of a health care system generally on the hospital-outpatient clinic-village dispensary model. This change of emphasis is certainly understandable, given the rapid advances made in medicine during this period. Environmental sciences simply had not developed sufficiently precise and refined quantitative techniques to support their theories of disease explanation.

The rebirth of interest in human population-vector-environment interactions since World War II has been encouraged by the increase in pathogen/vector resistance as well as by a growing understanding that disease plays a complex role in adaptation of humans to their surroundings and that its control may well require an understanding of a broad range of environmental factors.

## *CONTEMPORARY APPLICATIONS OF MEDICAL GEOGRAPHY IN THE DEVELOPING WORLD*

Excellent recent surveys of possible applications of medical geography in both the developing and the developed world have been published in McGlashen's (1972) collection, *Medical Geography: Techniques and Field Studies,* and in *The Geography of Health and Disease* (Hunter 1974). There are many possible directions of research, of which the more precise mapping and description of disease distribution and diffusion, a greater understanding of the geographical background of disease aetiology, and the better location of health care facilities and personnel seem most applicable to the problems of the developing world. Much, however, of what these contemporary studies emphasize and elaborate was earlier brought to the attention of the profession by L. Dudley Stamp (1964) in his book *The Geography of Life and Death*. Stamp believed that an interest in disease distribution by geographers should be a natural outgrowth of their concern with land use. This importance of understanding disease environments was particularly apparent in the developing world, where it was easier to see that travel decisions, settlement sites, and choices of economic occupation as well as land use were and are often critically influenced by considerations of health and disease.

Although the profession has from time to time made formal acknowledgment of this and a number of texts, such as Gourou's *The Tropical World* (1958) and Hodder's *Economic Development in the Tropics* (1968), devote considerable space to the relationship of disease to development, for the most part interest in disease has been limited, if not altogether ignored.[7] For example, regarding Southeast Asia, an important area of the developing world, neither of the two most widely used contemporary regional textbooks—Fryer's *Emerging Southeast Asia* (1970) and Dutt's *South East Asia: Realm of Contrast* (1974)—do little more than mention the existence of diseases within the region, let alone explore some of the constraints they may engender on "emergence" or some of the "contrasts" they may be responsible for providing.[8] Again, a survey of *The Journal of Tropical Geography*, produced by the Geography Department of the University of Singapore—which has more than just local interest and publishes a wide range of articles from other British Commonwealth universities, many of them in the developing world—revealed that in some twenty-five years of publication there were only three articles devoted to the geographical aspects of disease.[9]

Before medical geography can develop in all the specialized directions that have sometimes been suggested, or even generate a sufficient mass of literature so as to become a well-developed subfield within the discipline as a whole (a state which has been achieved by its sister discipline of medical anthropology), surely it is imperative to restore the awareness of and concern with health and disease as an integral factor in evaluating society's successful or unsuccessful adaptation to an environment.

Thus, a geography student of an area such as Southeast Asia should be as aware of the possible impact of clearing secondary jungle or abandoning cultivated lands on the incidence and distribution of diseases such as scrub typhus[10] as they are today aware of its effect on shifting agriculture. They should perceive the refuse and filth of the crowded squatter settlements clustering around so many Southeast Asian cities not just as examples of too rapid urbanization or the problems of the primate city but as new environments for disease, to which the local population may have little immunity and few powers of adaptation. Much of the material that geographers collect and report could with very modest changes be enlarged to reflect and illuminate this currently limited but often vital knowledge of the precarious relationship between society, environment, and disease in the developing world and could add a very important dimension to understanding the geography of these regions.

## *NOTES*

1. These are well documented in Taghi Farrar and Milton's collection of papers, *The Careless Technology* (1973).
2. See Malay 1920, pp. 15-16. The estate records of large companies such as Uni Royal Rubber in northern Sumatra support this. In the early years of estate clearance mortality figures among laborers typically ran at 25 to 30 percent in the Medan region.
3. Yaws, or framboesia, perhaps the most widespread skin disease in the tropics, is a rural disease associated with dirt and unhygienic conditions. A strictly tropical disease, it is caused by a microorganism related to the syphilis microorganism. Small cuts, such as may occur when walking barefoot or when harvesting padi rice with unprotected hands, are easily infected. Reports on its spread under Japanese occupation are found in Malaya 1952, p. 7.
4. See reports on these diseases in Taghi Farrar and Milton 1973 and Malaya 1959, pp. 15-19.
5. See, for example, the report on health services in Malaya in the *Malayan Bulletin* (1965). Malaysia has recently increased its rural medical services to benefit the traditional Malay peasant districts.

6. The theory of miasma was originally derived from Hippocrates but revived by Thomas Sydenham in the seventeenth century. Heat, moisture, dirt, and decay or corruption in mixed proportions were believed to be the chief sources of contamination that lead to disease.
7. The collection of papers edited by Steel and Prothero (1964) is a good example of this. Although there is a brief acknowledgment of the importance of disease in the tropics in the introduction, the papers in the text contain only one by implication concerned with health and disease. The rest are devoted to problems of climate, geomorphology, soils, land use, settlement, and migration.
8. A piece of field work recently undertaken by the author in a small town in western Java is a case in point. Although the district has been famous for polluted water supplies since before World War II and is today so well known for endemic malaria and hyperendemic typhoid and dysentery that the average citizen is aware of the considerable risks one takes in remaining there (certainly no self-respecting nineteenth-century geography or guide book would have omitted this information), no contemporary regional text, guide, or even local monograph refers to this. Indeed the community and region was described in a well-known text as an area of small pleasant market towns surrounded by padi rice fields and vegetable gardens and used as a take-off point for a discussion of agricultural systems in Java. At no time throughout the text was any environmental hazard to health mentioned although the importance of the tropical environment was thoroughly investigated in terms of soils, climate, vegetation, and of course agriculture.
9. Admittedly one of these is Ooi Jin Bee's very thoughtful examination of rural development in tropical areas (see Ooi 1959), which pays great attention to the influence of disease on the development of Malaya.
10. Malayan scrub typhus is a four-factor complex made up of mites, rodents, parasitic microorganisms (*rickettsia orientalis*), and man. Man contracts the disease when he enters an infected zone and is bitten by infected mites. It is commonly contracted in secondary forest regions, in abandoned mining or estate areas, or where new cover crops have been established on palm oil or rubber plantations. Cultivation or clearing and subsequent reversion to secondary forest result in the creation of multiple fringe habitats or "typhus islands" suitable for both rats and mites.

## REFERENCES CITED

Dutt, Ashok. *South East Asia: Realm of Contrast.* Dubuque, Iowa, 1974.

Fryer, D. *Emerging Southeast Asia.* New York: McGraw-Hill, 1970.

Gourou, P. *The Tropical World.* London: Longmans, 1958.

Hodder, B. W. *Economic Development in the Tropics.* London: Methuen, 1968.

Hunter, J. M., ed. *The Geography of Health and Disease.* Chapel Hill, N.C.: University of North Carolina, Department of Geography, 1974.

Malay, Federated States of. *Annual Report of the Medical Department.* Kuala Lumpur, 1920.

Malaya, Federation of. *Annual Reports of the Institute for Medical Research.* Kuala Lumpur, 1952, 1959.

*Malayan Bulletin,* "Report on Hospital Services," vol. 9 (1965).

McGlashen, N. D., ed. *Medical Geography: Techniques and Field Studies.* London: Methuen, 1972.

Ooi, Jin-Bee. "Rural Development in Tropical Areas." *Journal of Tropical Geography* 12 (1959) : 1-220.

Stamp, L. Dudley. *The Geography of Life and Death.* London: Fontana, 1964.

Steel, R. W. and R. M. Prothero, eds. *Geographers and the Tropics.* London: Longmans, 1964.

Taghi Farrar, M. and J. P. Milton, eds. *The Careless Technology.* New York: Natural History Press, 1973.

# *Applied Historical Geography and Landscape Studies*

**CHARLES F. KOVACIK**

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Many geographers have applied their expertise and research to problems affecting society (James 1972, pp. 427-53). The overall impact of geography in applied fields, however, has been minimal. Perhaps this has been the case because the discipline always has been relatively small in numbers and because better students were encouraged to pursue the Ph.D. to satisfy the demands of academia. Recently, however, geographers in increasing numbers have put more emphasis on applied research, and their efforts have had significant impact in such areas as land use, political redistricting, health care delivery systems, information portrayal, transportation networks, and environmental problems, to name a few.

All subdisciplines of geography have not participated with the same intensity in this recent upsurge of applied work. Historical geographers, at least as evidenced by published work, have been far behind. This is unfortunate because they long have argued the validity of an important concept whose impact increasingly has been recognized: past activities influence present and future geographic patterns.

This general lack of interest in applied studies results, at least in part, from the attitude of historical geographers themselves. Many view historical geographic research as basic rather than applied (Clark 1954, pp. 89-90). But good arguments can be made for both types of research, and one should not be discouraged in favor of the other. A second factor is that though many suggest that past geographies relate to present or future situations, in few cases is this view substantiated with evidence. Many historical geographers instead are concerned with the reconstruction of the past and with the identification, analysis, and interpretation of the processes affecting geographic change through time. It is in this area that perhaps the best published historical geographic research is manifested. In fact, the number of scholarly books published by historical geographers appears to be disproportionately high to their numbers, and I would estimate the ratio to be greater than that of other geographic subdisciplines. Many of these studies are concerned with certain periods of time rather than explicitly illustrating the relationship between the past and the present or future.

The limited amount, at least in published form, of applied historical geography is troublesome—troublesome because I believe that the historical geographer's point of view could be of great utility. Many historical geographers, especially those with rural or urban area specialities, have developed keen insights into how, when, and why certain landscapes came to be the way they are and can offer competent judgments about the future. This expertise apparently is being increasingly utilized by society, but the traditional and fundamental relationship between past, present, and future should be more evident in published research. Without that, the value of the historical geographer's unique perspective will not be fully recognized as useful to society.

This paper reviews some recent contributions in applied historical geography in the United States and suggests that research concerned with the landscape by historical geographers can elucidate the fundamental relationship between the geography of the past, present, and future. This is not a comprehensive review article, nor is there any claim that what is cited here is necessarily the best work. Its intent simply is to bring attention to some types of applied historical geography and to illustrate that the landscape has potential for applied historical geography. In addition, it is not proposed that historical geographers abandon their individual research orientations, that boundaries be set for the subdiscipline, or that applied work become the end of all research. Indeed, the landscape concept emanated from basic research, and now it can be used to further efforts in the applied areas. Both types of research are interrelated, and one should be well trained in the fundamentals of each. Although some might wish to reorganize graduate programs and even harshly modify the discipline to take advantage of employment opportunities, it is the enduring concepts, not the questions of the moment, that are the foundation of geography.

## *THEMES IN APPLIED HISTORICAL GEOGRAPHY*

Because of the nature of much applied historical geography, usually very specialized in area or topic, it does not generally reach print in geographic journals. But one should not assume that specialists in this field fail to participate in applied research. On the contrary, the session entitled "Applied Historical Geography," organized by Robert Janiskee and A. J. Lamme at the Association of American Geographers meeting in Salt Lake City, revealed that a considerable amount of such work is being done. Some of this is published, though generally locally—and as a result such studies remain unknown to most geographers. Research by historical geographers has been included in testimony before courts of law; in reports to local, state, and national agencies; and in oral communication to decision makers ranging from city council members to Congressional committees. One example of an area in which historical geographers have applied their expertise and which is gaining some recognition in the profession is forensic geography:

the use of geographic information or application of the geographic perspective in formulating cases for litigation. Many of us are probably aware that geographers are called upon to act as expert witnesses in legal proceedings. E. S. Easterly and Milton Newman are developing a forum on forensic geography involving lawyers, judges, and geographers. They will discuss (1) the geographer as witness and consultant, (2) the scope of expert testimony, and (3) the presentation of geographic evidence in legal proceedings. Once again, there has been little attention devoted to such matters in the geographic literature.

Another example, in the cultural or historical tradition, is an abstract of a paper presented by Homer Aschmann (1954, p. 604). The United States Indian Claims Commission called upon Aschmann for expert testimony relating to how particular Indian tribes used their lands. Perhaps the most widely known recent work in applied historical geography is that by De Vorsey concerning the determination of Florida's seaward boundary (1973, pp. 214-20). De Vorsey outlines the "methodology and expertise peculiar to historical geography...as it was applied in a litigation before the Supreme Court of the United States" (1973, p. 214). The case involved Florida's claim that its historic boundary extended nine rather than three miles into the Gulf of Mexico. De Vorsey assisted in locating the historic boundary, and Florida won the case, which entitled the state to claims of submerged lands and sea bed resources up to nine miles from its Gulf coastline. In a somewhat similar situation the state of South Carolina asked a colleague, John Winberry, and me to research a boundary problem involving the Savannah River and Georgia. It is rumored, interestingly enough, that De Vorsey is working in a similar capacity for Georgia.

A second area with great potential for applied work involves historic preservation and preservation planning. Many historical geographers are involved in preservation-related work but, because most of this work is done locally, evidence concerning particular projects is scarce. Certainly there are many who serve on local preservation committees. These individually may make recommendations based upon their expertise, but such activity is generally not appropriate for publication in traditional outlets.

The recent accessible research includes six papers presented in a special session entitled "Historic Preservation and the Management of Geographic Environment" at the 1974 Association of American Geographers meeting and some published material described below which is far more provocative than voluminous. The published work deals with American attitudes toward the past, reactions and arguments regarding the concept of preservation, and the role of geographic expertise in preservation problems.

Without a doubt, much of the recent research interest owes a great debt to the writings of John B. Jackson, Fred Kniffen, Peirce Lewis, David Lowenthal, Donald Meinig, Yi-Fu Tuan, and others who have successfully articulated the theme of continuity of place through time. Lowenthal provides some especially interesting insights into attitudes of Americans toward the past and indirectly describes how many historical geographers react to most completed preservation projects (1966, p. 27): "In America most memories are short; the relics of history are often unrecognized, and few deplore their passing: so rare an element is the past that when it is appreciated it becomes The Past, an Historical Heritage—not a natural part of the landscape, but a special feature fenced off in a preserve called History. It may be touched, handled, tasted, even participated in, as at Williamsburg: but it is not a part of everyday life. Either neglected or put in museums, the American past is not permitted to coexist with the present. It is always in quotation marks and fancy dress."

Despite this apparent isolation of history, Lowenthal argues that "tangible evidence of the past" supplies some basic societal needs. Specifically he notes that the past is needed so that we can cope with present landscapes; that if people know that structures are durable, they will have a sense of being rooted in place; and that "durable national ideals" are supported by history in the landscape (1975, pp. 5-21). Peirce Lewis is sympathetic to Lowenthal's position but is most concerned with the effects of urban renewal, growth of the modern multinucleated city, and the disappearance of central business districts (1975b, pp. 32-41). Central cities, he claims, always have been important to Western society: "Downtowns, with their monuments, their plethora of public and private memories, are necessary for continuity, whether or not they are places of immediate financial profit" (1975b, p. 36). He urges preservation of entire center-city districts, not just individual buildings, and points to the large-scale preservation of New Orleans' Vieux Carré as both aesthetically and economically beneficial. Lewis also describes the preservation movement as "a thundering failure" and suggests that preservationists have utilized ineffective arguments (1975a, pp. 1-20). He presents five arguments for preservation: (1) cultural memory, (2) antique texture, (3) successful proxemics, (4) environmental diversity, and (5) economic gain.

Larry Ford, however, notes that as the central business district increasingly has become sterile; it offers little to preserve. As a result, urban preservation efforts are becoming concentrated in the area of transition, or in what he calls the "zone of discard" (1973, pp. 33-37). Such a place usually is perceived as dull and derelict, but within it planners and developers find meaning and continuity. Preservation has benefited communities and has helped change the image from a negative or low priority area to "an ideal location to enjoy a human-scale setting and a sense of temporal continuity and place" (Ford 1974, p. 36). Ford also argues that the historical geographer's interest in the evolution of place is vital to preservation planning (1975, pp. 1-15). He identifies and discusses the following areas in which historical geographers can contribute to urban preservation planning: (1) for a sense of place; (2) for human scale; (3) for a sense of community; (4) for social equity; (5) for workability, design creativity, texture, and depth; and (6) for preservation of urban functions.

Historic preservation is not limited to urban environments. John Jakle and Robert Janiskee urge historical geographers "to further focus on the relic features of the landscape as vital elements of today's and tomorrow's geographical environment" and suggest that such landscapes be considered "as environmental resources to be managed toward a betterment of human life" (1975, p. 194). They present a case study which includes ways that historical geographers may encourage historic landscape preservation in rural areas which "are endowed with relic landscape resources" (1975, p. 195). Janiskee has elaborated on the rural relic landscape preservation theme and suggests a recreational rationale (1976, pp. 107). Robert Newcomb, although concerned with a Danish preservation problem, discussed a number of ways a historical geographer "can serve as a contributing specialist" in the planned preservation of "landscape legacy resources" (1967, p. 474).

## *LANDSCAPE STUDIES*

The identification, description, and interpretation of landscapes, landscape features, and their evolution have been topics of basic research for historical geographers. But these themes can also be applied meaningfully to present-day problems and situations. Such research contributes to a better understanding of human activity on the earth and can also substantiate the traditional claim that the past relates to present and future geographic patterns. The landscape theme is particularly significant to applied geography since it is oriented to real world situations. It represents a starting point, an end product, and a basis for speculation about the future.[1] Landscape studies provide an excellent opportunity for historical geographers to develop and display their expertise.

The landscape theme is not new to the discipline and has been debated and modified since Carl Sauer introduced it to geography in North America over half a century ago (1925, pp. 19-54). Largely because of the propensity in American geography to entertain energy-consuming debates over what is and what is not geography, or what is the best or poorest methodology, the landscape theme, like others, has suffered. Hugh Prince claims that, because of Hartshorne's definition of the nature of geography, the genetic approach to landscape features was discouraged and few vertical studies have been made in North America (1971, p. 18). The dearth of landscape studies is noted by Donald Meinig: "there has been a handful of American geographers who have been working on more comprehensive and interpretative approaches to landscape study," but "it is a field of great potential but as yet of relatively little accomplishment..." (1971, p. 3).

Many associate students of the landscape with the Berkeley school or with Fred Kniffen and his students. Despite questions and debates concerning their approach, these two traditions have contributed much to the study of landscape and maintenance of a special feeling and appreciation for landscape as well as its diffusion to other "schools of thought." These two schools of the cultural landscape no longer hold sole claim to this theme even though the lineage of some of the most articulate students of landscape can be traced, directly or indirectly, to them. Some of the more recent contributions represent a much broader spectrum of the discipline and interpretation of the concept itself.

There are numerous approaches to the study of landscape, but historical geographers find a special affinity to the subject because it is a temporal as well as spatial phenomenon. Perhaps H. C. Darby best articulated the reason for this interest: "The landscape we see is not a static arrangement of objects. It has become what it is, and it is usually in the process of becoming something different" (1954, p. 37). It is not within the scope of this paper to review the literature concerning landscape. Rather, I have chosen a few studies that demonstrate the fundamental relationship between the past and present and how a historical geography has contributed to the interpretation of the present-day landscape.

Vertical landscape studies are concerned with origins, form, function, changes, geographical distribution, and areal associations of present-day features. They may focus on individual features or areas, either rural or urban. Some examples of such studies appear in a number of journals, including the interesting and readable journal entitled *Lanscape,* specifically devoted to landscape topics. It is replete with contributions from, among others, geographers, English professors, ecologists, historians, and architects concerning individual landscape features ranging from porches to baseball diamonds.

Two articles from geographical journals may serve as examples of the historical geographer's scope and craft in explaining individual landscape features. Both focus on commonplace, ubiquitous, obvious, but relatively uninterpreted features of the landscape. Charles Aiken's well-illustrated study examines the cotton gin and cotton-ginning industry (1973, pp. 196-224). He traces its origins and the role of Eli Whitney, technological change through time with respect to form and function, distribution, and the relationship of these changes to cotton farming. John Winberry and David Jones examine kudzu, a rapidly growing vine which once threatened to engulf the countryside (1973, pp. 61-70). It is presently a common rural landscape feature which is admired by travelers for its "eerie, fantastic scenes" but blasphemed by farmers as it spreads and climbs over abandoned structures, telephone poles, fields, trees, and anything else in its path. The paper traces its introduction as an ornament, its use as pasturage and hay, its widespread use in soil conservation, and its present status as a pest to Southern agriculturalists.

The relationship between past and present also is elucidated in vertical studies concerned with rural or urban areas at either the macro- or micro-levels. Although John Fraser Hart's book has been accused of being unorganized, narrow, too short, and too rural, it provides a keen insight into why portions of the landscape are the way they are, especially in the Midwest (1975). It is recommended reading for those curious about the rural landscape. At the micro-level, Merle Prunty's work on the Southern plantation is outstanding (1955, pp. 459-92). Though the study is dated, the excellent diagrams depicting the varying form of plantations classified as antebellum, fragmented (croppers and tenants), and neoplantation (mechanized) illustrate how changes through time are reflected in the landscape.

Even though most Americans live in cities and urban geographers are numerous, surprisingly few studies of the urban landscape exist. Harold Mayer, with the help of a historian, authored a book which clearly shows the relationship between the past and present in Chicago (1969). It is essentially a photographic essay. The text is well integrated with the visual matter, and the changing geographical patterns, relationships, social geography, and cityscape are both meaningful and understandable. Peirce Lewis traced the origins and periods of change as they related to Bellefonte, Pennsylvania: "latecomers are likely to find the contemporary stage-set baffling without some knowledge of what preceded it" (1972, p. 332). Bellefonte is but one of thousands of American small towns, and Lewis shows that the landscape and problems of the small town in the United States are products of the past. He uses a similar approach in studying New Orleans and accounts for why the "Crescent City" is the way it is and looks the way it looks (1976).

## *CONCLUSION*

Historical geography is contributing useful applied research, and its contributions will increase in the future. To date, the results of such work are not especially apparent because they are either unpublished or published locally and do not appear in traditional outlets.

Forensic historical geography is the most widely known type of applied historical geography, but more historical geographers are involved in historic preservation and preservation planning. Landscape studies, besides being an excellent medium for illustrating the usefulness and applicability of historical geographic research to present-day situations and problems, may hold the greatest potential. Knowledge of landscapes is important to society for both practical and aesthetic reasons.

The variety of societal problems and the lives we lead are set in the landscape. To solve the problems which beset our society, it seems paramount that we know more about landscape. We must know more about landscape in a holistic sense, which includes both the spatial and temporal contexts, not just bits and pieces. How can society effectively react to, propose, and support solutions to problems without being aware of the milieu in which the problems are set? Lowenthal poses some pertinent questions: "To what extent are people aware of their surroundings at all, and when and where? How much do we really see at home, on vacation, on the way to or from work, in field or factory, office or classroom?" (1968, p. 77).

Most geographers have experienced the pleasure and intellectual stimulation associated with field work or field trips. In the field we apply our knowledge of the complex relationship between man and environment to the landscape. Some of the most satisfactory experiences result from situations in which the landscape is particularly difficult to interpret. On these occasions we enthusiastically interact with colleagues in both substantive and speculative discussions. We return to our offices revitalized, refreshed, and with new insights and questions regarding the world around us. If we take students on field trips, and too few of us do, we see the joy and excitement of those who discover and gain an understanding of a landscape feature that was never really understood before. The aesthetic value of landscape is apparent to us. But what of society?

The notion of landcape aesthetics or landscape appreciation is gaining more attention (Meinig 1971; Lewis, Lowenthal, and Tuan 1973). It will require a closer alliance with the humanities: "The appreciation of landscape is more personal and longer lasting when it is mixed with the memory of human events. It also endures beyond the fleeting when aesthetic pleasure is combined with scientific curiosity" (Tuan 1974, p. 95). Historical geography can provide the key to landscape aesthetics. It can make more evident the relationship between the humanities and sciences. It can encourage society really to look at, become curious about, understand, and enjoy the landscape. The result will be the enrichment of the human experience.

## NOTE

1. Debates concerning ideographic versus nomothetic or particularistic versus theoretical are of little consequence to applied historical geography and probably much other related research.

## REFERENCES CITED

Aiken, Charles S. "The Evolution of Cotton Ginning in the Southeastern United States." *The Geographical Review* 63 (April 1973) :196-224.

Aschmann, Homer. "Cultural Geography: Applied and Theoretical." *Annals of the Association of American Geographers* 55 (December 1965) :604.

Clark, Andrew H. "Historical Geography." In Preston E. James and Clarence E. Jones, eds., *American Geography: Inventory and Prospect,* pp. 70-105. Syracuse, N.Y.: Syracuse University Press, 1954.

Darby, H. C. "On the Relations of Geography and History." *Journal of the Institute of British Geographers* 19 (1954) :1-11. Reprinted in Fred E. Dohrs and Lawrence M. Sommers, eds., *Cultural Geography: Selected Readings,* pp. 30-42. New York: Thomas Y. Crowell, 1967.

De Vorsey, Louis. "Florida's Seaward Boundary: A Problem in Applied Historical Geography." *The Professional Geographer* 25 (August 1973) :214-20.

Ford, Larry. "Historic Preservation and the Sense of Place." *Growth and Change* 5 (April 1974) :33-37.

______. "Historic Preservation and the Stream of Time: The Role of the Geographer." *Historical Geography Newsletter* 5 (Spring 1975) :1-15.

Hart, John Fraser. *The Look of the Land.* Englewood Cliffs, N. J.: Prentice-Hall, 1975.

Jakle, John A. and Robert L. Janiskee. "Why Covered Bridges? Toward the Management of Historical Landscapes—The Case of Parke County, Indiana." In Ralph E. Ehrenberg, ed., *Pattern and Process: Research in Historical Geography*, pp. 193-201. Washington, D. C.: Howard University Press, 1975.

James, Preston E. *All Possible Worlds: A History of Geographical Ideas.* New York: The Odyssey Press, 1972.

Janiskee, Robert L. "City Trouble, the Pastoral Retreat, and Pioneer America: A Rationale for Rescuing the Middle Landscape." *Pioneer America* 8 (August 1976) :1-7.

Lewis, Peirce F. "Small Town in Pennsylvania." *Annals of the Association of American Geographers* 62 (June 1972) :323-51.

———. "The Future of the Past: Our Clouded Vision of Historic Preservation." *Pioneer America* 7 (July 1975) :1-20.

———. "The Right Kind of Preservation, on a Creative Scale, Can Save Our Disappearing Downtowns." *Smithsonian* 6 (September 1975) :32-41.

———. *New Orleans: The Making of an Urban Landscape.* Cambridge, Mass.: Ballinger Publishing Company, 1976.

Lewis, Peirce F., David Lowenthal, and Yi-Fu Tuan. *Visual Blight in America.* Commission on College Geography Resource Paper 23. Washington, D. C.: Association of American Geographer, 1973.

Lowenthal, David. "The American Way of History." *Columbia University Forum* 9 (Summer 1966) :27-32.

———. "The American Scene." *The Geographical Review* 58 (January 1968) :61-88.

———. "Past Time, Present Place: Landscape and Memory." *The Geographical Review* 65 (January 1975) :1-36.

Mayer, Harold M. and Richard C. Wade. *Chicago: Growth of a Metropolis.* Chicago: University of Chicago Press, 1969.

Meinig, D. W. "Environmental Appreciation: Localities as a Humane Art." *Western Humanities Review* 25 (Winter 1971) :1-11.

Newcomb, Robert M. "Geographic Apects of the Planned Preservation of Visible History in Denmark." *Annals of the Association of American Geographers* 57 (September 1967) : 462-80.

Prince, Hugh C. "Real, Imagined and Abstract Worlds of the Past." *Progress in Geography, International Reviews of Current Research* 3 (1971) :1-86.

Prunty, Merle C. "The Renaissance of the Southern Plantation." *The Geographical Review* 45 (October 1955) :459-91.

Sauer, Carl O. "The Morphology of Landscape." *University of California Publications in Geography* 2 (1925) :19-54.

Tuan, Yi-Fu. *Topophilia: A Study of Environmental Perception, Attitudes, and Values.* Englewood Cliffs, N. J.: Prentice-Hall, 1974.

Winberry, John J. and David M. Jones. "Rise and Decline of the 'Miracle Vine': Kudzu in the Southern Landscape." *Southeastern Geographer* 13 (November 1973) :61-70.

# *The Evaluation and Preservation of the Cultural Landscape*

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## *THE APPEARANCE OF THE CULTURAL LANDSCAPE*

During the last couple of decades the concept of perception of the environment has become the theme of one of the most rapidly growing areas of research in cultural geography. At the same time public concern for the protection and improvement of the quality of the environment has revived the consciousness of geographers with regard to the most fundamental concept of geography, the man-land relationship. After a period during which the development of spatial theory received priority, the ecological movement of the late 1960s rather belatedly alerted geographers to the fact that they were no longer the leaders in the field of study of man's relationship with his environment.

The ecological movement focused its attention primarily on the problem of man's use and misuse of the natural environment. The quality of the man-made environment became a major concern, and the term "visual pollution" or "visual blight" as applied to the ugly or unsightly appearance of elements of the cultural landscape became popular. The same trends and forces which were lowering the quality of our air, water, and vegetation were seen to be producing urban blight and the deterioration of rural landscapes.

Before the full impact of the ecological movement made itself felt, however, a small but active group of cultural geographers had already begun in the early 1960s to express interest in and concern for the appearance of the cultural landscape. Their studies analyzed the factors which led to the formation of the cultural landscapes of the United States and England and showed that their divergent development was due to differences in landscape tastes. Notable contributions were the works of Lowenthal and Prince (1964, 1965) on the English and Lowenthal (1968) on the American landscape. These studies of perception of landscape are different in spirit and intent from historical-geographical studies, such as Hoskins' work (1955) on the making of the English landscape, Orme's study (1970) of Ireland, or Lambert's analysis (1971) of the Dutch landscape. Lowenthal is interested primarily in the subjective element in people's perception of the landscape and in analyzing the reasons for the development of the particular attitudes which they have adopted in the creation of their man-made environment.

Any consideration of people's subjective attitudes to landscape inevitably raises the question of aesthetic judgment. The problems involved for a geographer in posing as a landscape critic have been analyzed by Lewis. He points out that understanding a landscape is quite different from setting oneself up as a landscape critic (Lewis et al. 1973, p. 7). Nevertheless, he urges geographers to be concerned about visual blight. He is joined by Lowenthal (Lewis et al. 1973), Yi Fu-Tuan (Lewis et al. 1973), and Meinig (Lewis et al. 1973). At an earlier date Lowenthal (1962-63) had already raised the question of our criterion for scenic beauty, and Meinig (1971) had also looked at the concept of environmental appreciation.

The basic problem regarding an evaluation of the aesthetic qualities of a given landscape lies in the great variation of personal reactions on the part of the public and the impossibility of selecting one particular judgment as the most appropriate. However, if we in fact wish to act in order to preserve, conserve, transform, or remove the elements of a particular landscape, then some method for landscape evaluation must be devised.

## *TYPES OF CULTURAL LANDSCAPES*

Before considering methods and techniques for evaluating the cultural landscape, some clarification of the term "landscape" is necessary. For purposes of visual evaluation the most practical definition (Webster Universal Dictionary) is "an actual tract of country and all its features considered as scenery." Unwin's more scientific definition is "the appearance of the land at the interface of the earth's surface and atmosphere" and thus "a composite of the visual aspects of all other land parameters" (1975, p. 130). In other words, the popular definition of a landscape is closer to our purposes than the more specialized definitions developed by physical geographers and others. We are primarily interested in the visual impressions we receive when looking at a particular scene. In fact, we could substitute the term "scenery" for "landscape" without much loss of meaning. In the case of the cultural landscape we are concerned with the appearance of that part of the scenery that shows the imprint of human activities.

In observing the cultural landscape, we can clearly distinguish several categories of landscape types, the most obvious being rural as opposed to urban. A basic classification of man-made landscapes by the Soviet Geographer F. N. Mil'kov has considerable practical value. His classes are (1) agricultural, including agrarian, horticultural, and meadow-pasture; (2) settlement, including rural settled and urban; (3) industrial; (4) man-made water; and (5) man-made forest (1973, pp. 58-139). Any cultural landscape which we may observe will fall into one or other of the above categories or may be a combination of two or more.

## *METHODS AND TECHNIQUES FOR LANDSCAPE EVALUATION*

Serious attempts to devise techniques for the evaluation of landscape took place in Great Britain in the late 1960s. With the transformation of rural areas by the rapid spread of urbanization and industrial development, the necessity of taking stock of the most valuable scenic areas and of organizing some method of protecting them became clear. A debate arose on the subjective element in landscape evaluation, with notable contributions from Clark (1968) and Weddle (1969) and later from Craik (1972) and Unwin (1975). Unwin looks at the physical, perceptual, and evaluative relationships of the observer to the landscape and summarizes the problems of measuring quality (1975, pp. 131-33).

One of the first practical attempts at landscape evaluation was that of Fines in East Sussex. He showed a number of photographs of selected landscape and townscape views to a group of people. One photograph was selected as a "control view" and assigned a value of 1.0, and each member of the group was asked to assess numerically the other landscape photographs in relation to the control photograph. Results were analyzed by subgroups according to sex and the amount of training in a design discipline. A range of values for each subgroup was obtained. Fines arrived at a scale of values from 0 to 32 (ranging from "unsightly" to "spectacular") that was based on the mean values of the test views of the group with experience in a design discipline "as they are most likely to obtain the greatest enjoyment from landscape and their scale approximates to an absolute scale which will hopefully approach that of the majority" (Fines 1968, p. 43).

Fines' methodology was strongly attacked by Brancher, who considered the selection of the values of the subgroup with experience in design as "mind-boggling in its assertions, as if education and leisure in the fullness of time will confer their value on others." However, even if Fines' study does not offer anything new beyond the subjective level of landscape appreciation, subjective appraisal is the only method we have (Brancher 1969, p. 91).

Two important and relevant problems in the practical evaluation of landscapes are obvious: (1) who is to carry out the evaluation, and whose opinions should be sought on the appearance of a landscape; and (2) how can the subjective element in evaluation be eliminated or at least reduced? Another attempt to evaluate the scenery of a large area of countryside was made by Linton in Scotland (1968). He rejected Fines' scales of numerical values as having no clear logical basis and thought that the method was too expensive in terms of labor except for a small and wealthy area. Linton used six types of "landform landscapes" and seven types of "land-use landscapes" (in other words, cultural landscapes). The region to be studied was divided into tracts, each given a score from both of the scales. These scores were then combined to give a composite assessment. The practicality of the method lay in the fact that it could be done from maps and required no field work. Gilg used Linton's method in a study of the Lomond Hills area of Scotland and found it "useful and capable of producing valid results without a great deal of field labour, laboratory analysis or statistical procedures" (1976, p. 49). He suggested some modifications of the original method.

Linton's method avoided answering the above two questions. The evaluation of the scenery was made by relatively untrained operators who studied the relief components of the landforms shown on a map and rated their attractiveness on the basis of their steepness, ruggedness, and boldness. It did not really solve the problem of evaluating the quality of the landscapes (Clout 1972, p. 132). The operator did not evaluate or express views on the aesthetic aspects of the landscape but instead identified and classified landscape components.

Another type of landscape evaluation study was undertaken in the Coventry-Solihull-Warwickshire subregion in 1970, and at a later date the same method was applied by Blacksell and Gilg to southeast Devon. This method used a landscape preference measurement, based on visual quality, as the dependent variable in a stepwise multiple regression, with measured landscape elements as the independent variable. The regression coefficients were then used as weights and applied to each measured landscape element to simulate visual quality (Blacksell and Gilg 1975, p. 136). Problems arise in this system from the interpretation of visual quality assessments on a scale of 0-26 and with the regression analysis (Blacksell and Gilg 1975, p. 137). Methods, particularly applicable to the evaluation of the natural landscape, have also been devised by Leopold (1969), Morisawa (1971), and others.

## *EVALUATION OF THE CULTURAL LANDSCAPE*

It will be noted that the methods discussed above are intended for the evaluation of a combination of natural and manmade landscapes. In fact, they are basically designed for rural landscapes, although some urban components are included. Linton, however, specifically excludes the evaluation of urbanized landscapes from his method as he does not consider them scenic resources, even if they contain features of interest (1968, p. 231).

Although methods for the evaluation of all types of landscapes should be devised for the rapid and comprehensive analysis of a region's total landscape resources, it can be argued that methods specifically designed for the evaluation of the cultural landscape should also be developed. The evaluation of the manmade environment involved certain problems which are not found in the assessment of the attractions of natural scenery.

The designers of techniques for the evaluation of natural scenery have differed in their views as to who should make quality judgments: the person in the street or someone with a more specialized approach and training. If a certain natural landscape is to be evaluated for possible preservation for the enjoyment of the general population, then surely the judgment of representatives of the public should be taken into account. An exception to this rule can be argued in the case of a rare or unusual geological formation, or areas containing threatened species of vegetation or animal life. In these cases the specialists' views must be heard. However, these specialists are not stating their opinions on the aesthetic value of the landscape but on its scientific significance, quite a different matter.

In the case of the cultural environment, evaluation by a lay person becomes more difficult. When we are considering the cultural landscape from the point of view of its possible preservation, its aesthetic appearance is only one of the number of considerations that must be taken into account. If, for example, we are attempting the evaluation of an area of agricultural land that is threatened by the expansion of a nearby city, several factors should be considered. First is the assessment of the general attractiveness. This judgment could be made by representatives of the general public. Second, an evaluation of the unique character of the agricultural landscape must be made. It may be part of a large area where field patterns and and settlement types are uniform, or it may be an area of a rare or vanishing type of farming. In this case the views of an expert are necessary. Third, the individual components of the landscape must be taken into account, such as house types, barns, fences, and hedgerows, to see if there are any unique features worthy of preservation. Again, this is a task for the specialist. Finally, if the area is deemed worthy of preservation, for any combination of the above reasons, then decisions must be made whether to preserve the entire area or part of it, taking into account cost factors and competing land use. This final stage, of course, occurs also in the case of preservation of areas of natural beauty and lies outside the area of visual evaluation.

The judgment of the specialist is even more important during evaluation of the urban landscape or "townscape." In the case of urban buildings, an estimation of their historical importance is necessary, along with opinions on their aesthetic and architectural value. Evaluation of townscapes cannot be entrusted to the visual impressions of the general public alone. We are thus undertaking a different type of process than that involved in the landscape studies of Linton, Fines, and others. It is possible that a building may be rated highly as a historical or architectural monument but may rank low on the scale of visual attractiveness.

## *PRESERVATION OF THE RURAL CULTURAL LANDSCAPE*

Before considering techniques for the evaluation of the cultural landscape, its aims must be clearly understood. An evaluation could be made as part of a general inventory of resources or as a basis for classification of regional landscapes. In the present case we are considering the cultural landscape and its components from the point of view of preservation for posterity. Thus, a special purpose exists and will influence the development of the evaluation techniques. In fact, as will already be obvious, most evaluations are undertaken to facilitate decisions on preservation, but the point is worth stressing because it influences the role of the participants in the evaluation process and the development of techniques.

Preservation of the rural cultural landscape can take several forms. A large tract of land can be protected from further encroachment by urban or industrial development and its field patterns, villages, and farms kept in their original form. This level of preservation is rarely found unless the region is also classified as an area of natural scenic beauty. In Great Britain the criterion for the establishment of a national park or an area of outstanding natural beauty is primarily the natural beauty of the landscape and its unspoiled character, although in the case of national parks, "opportunities for...maintaining the agricultural use of the land" are also afforded (Great Britain 1972, pp. 23-24). This does not mean, however, that the quality of the agricultural landscape per se is necessarily taken into account.

It can be argued that the subsidization of farmers in the Alpine countries of Switzerland and Austria is an indirect form of preservation of the cultural landscape. Without subsidies most of the agricultural villages of the Swiss Alps would have vanished and the traditional cultural landscape, so attractive to the tourist, would have been radically changed. The Swiss farmer has in many cases become a state-supported landscape gardener.

It is more common to find the preservation of the rural cultural landscape restricted to small areas. In the Netherlands "agricultural areas with a valuable landscape" are earmarked for preservation along with zones for recreation as elements in larger regional plans for land consolidation, urbanization, and industrialization. Considerable work has been done on landscape typology for planning purposes by Visscher (1972) and Roorda van Eysinga (1969). The latter developed a typology of the rural landscape of the region around the city of 's-Hertogenbosch which has been used as a basis for recreational planning. In England one of the few surviving areas of open-field farming has been preserved at Laxton in Nottinghamshire. In Denmark historical village districts are preserved (Newcomb 1967, p. 471).

In cases where an old cultural landscape has vanished, leaving a few relict farms and other buildings, it is possible to preserve at least some of the elements of the original landscape either in situ or in an open-air museum. Farms and other rural buildings may also be moved and preserved even before the region becomes threatened, either as a precautionary measure or in order to complete a collection of buildings of all types from all parts of the country. Examples of museums of this type are Skansen in Sweden, the village museum at Bucharest in Romania, Seurasaari in Finland, Bokrijk in Belgium, Arnhem in the Netherlands, and the Lapp museum at Inari in Finland, to mention only a few. In many cases an attempt is made not only to preserve the farmhouses, barns, and sheds with their contents but to place them in their original grouping, surrounded by a fence or hedge. In this way an aspect of the original environment is retained.

Geographers have never expressed much interest in the subject of open-air museums, and their development has been left primarily to ethnographers. However, with the cultural geographer's interest in house types, it is to be hoped that more of them will become involved in the development and planning of these repositories of important elements of the cultural landscape. Newcomb has reviewed many of the problems involved in the preservation of cultural landscapes and their elements, with special reference to Denmark. In particular, he emphasizes the role of the open-air museum as an answer to some problems of preservation and maintenance of buildings and village units (Newcomb 1967, p. 477).

Although the cultural geographer may share the interests of other specialists in the preservation of individual elements of the landscape, he should be particularly involved in problems involving landscape complexes, for which his training eminently suits him and where he can make his greatest contribution.

## *PRESERVATION OF THE TOWNSCAPE*

Preservation of the landscape of the town or city follows a rather different pattern from that of rural areas. It is rare for whole cities or even large districts of cities to be completely preserved and no further development permitted. Some towns have been preserved as virtual museums, such as Carcassone, the fortress town in the south of France, Williamsburg in Virginia, Dubrovnik in Yugoslavia, and Rothenburg in Germany. The inhabitants of a town, however, must make a living; and new commercial, industrial, and residential buildings are inevitably erected. In the case of the urban landscape the word "conservation" is perhaps more suitable than "preservation." Preservation suggests a static condition, maintaining the situation as it is. Conservation implies that the object preserved can also be used. Conservation of a townscape means that the buildings and streets will be put to modern uses. The term "conservation" is also applied to groups of buildings or areas of towns, while "preservation" generally refers to individual buildings (Burke 1976, p. 117).

Conservation of townscapes consists mainly of the protection of historic town centers, including their buildings and street plans; of groups of buildings, often along a street; and of individual buildings. In Europe the conservation of townscapes received great encouragement from the declaration of the year 1975 as "European Architectural Heritage Year" with the support of UNESCO. The aim of the declaration was to awaken public interest in the maintenance of old buildings and settlements, to warn against the dangers which threatened their preservation, and to ensure their continued existence in an unspoiled state and as a living part of the social environment. However, even before this date several European countries had already developed plans and the necessary institutions to ensure conservation of their historic towns and cities. In Great Britain the work of the National Trust, begun in 1895, has been supplemented by the activities of the Historic Buildings Councils for England, Scotland, and Wales. The Town and Country Planning Acts of 1969 and 1971 require the compilation of lists of buildings of historical or architectural interest. Demolition or alteration of any of the buildings on the list requires special permission from local planning authorities. If a building is neglected by its owner, it may be bought compulsorily by the appropriate minister or local authorities (Great Britain 1972, pp. 33-34). In 1964 the Council for British Archaeology pointed to the importance of preserving the street plans of historic cities. It published a list of historic towns and supported the idea of a survey of the historic environment, with the aim of saving areas threatened by plans for destruction of the historic street plan in order to facilitate modern traffic flows. Many of the ideas of the council were incorporated in the Civic Amenities Act of 1967, which gave local authorities power to declare areas of special architectural or historical interest as Conservation Areas, which would receive special attention. However, these areas would not be preserved unaltered but would be permitted to develop under careful control (Burke 1976, pp. 132-33).

In Czechoslovakia (as an example from Eastern Europe) much work has been done on the conservation of historic towns. Between 900 and 1,000 towns have been classified as having historic centers which are worthy of consideration for conservation. The State Institute for Reconstruction of Historic Towns and Monuments is responsible for all development within these historic town centers and employs specialists in disciplines connected in town planning. Detailed survey work has been carried out at a scale of 1:1,000 (Morris 1973, p. 814).

Conservation of historical or architecturally attractive buildings is not the only action necessary to improve a townscape. At the same time, removal of unsightly buildings, signs, advertisements; planting of trees; creation of parks; barring of traffic; and other similar actions may be necessary in order to complete the urban beautification process and control the further growth of urban blight.

## *PRESERVATION OF THE INDUSTRIAL LANDSCAPE*

Some mention should be made of the growing interest in many countries in the preservation of factories, buildings, machines, canals, railroads, and other structures which form elements of the landscape of the Industrial Revolution. The field of industrial archaeology has been growing rapidly in Great Britain, and considerable public interest has been aroused in the subject. It should be noted that the preservation of structures from the time of the Industrial Revolution is in most cases not based on any considerations of aesthetic beauty, and in some cases arguments can be made against their retention as a feature of the landscape. Attitudes toward industrial landscapes have changed, however, over the years (Peters and Anderson 1976). It is possible that the buildings of an old iron works or coal mine may seem quaint and attractive to future generations.

## *TECHNIQUES FOR EVALUATING THE CULTURAL LANDSCAPE*

As a first step in the evaluation of the cultural landscape for the purposes of conservation or preservation, a preliminary inventory of landscape components must be made. This inventory may best be made with the aid of topographic maps and aerial photographs. The method developed by Linton (1968) and utilized by Gilg (1976) for assessing scenery can be adapted for this purpose. Gilg used British Ordinance Survey maps at a scale of 1:25,000. The area was divided into ten kilometer squares, which in turn were divided into sets of five columns and five rows, each column or row being two kilometers wide. By allocating the rows and columns to groups of students for analysis and assessment of categories of scenery, he arrived at a composite score (Gilg 1976, p. 42). For inventory purposes, however, it is not necessary to assess the scenic or other values of the landscapes in the study region but simply to classify them. Thus, it is not necessary to allocate rows and columns to analysis, which involves the study of each square by two groups in order to check consistency. Each map sheet can be analyzed square by square by one person.

A system of classification using numbers or letters should be used to indicate the components of the cultural landscape contained in each square. Linton used seven "land-use landscapes": (1) urbanized and industrialized landscapes, (2) continuous forest, (3) treeless farmland, (4) moorland, (5) varied forest and moorland landscapes, (6) richly varied farming landscape, and (7) wild landscapes (1968, pp. 230-32). However, these categories were designed for the evaluation of scenery, and not for inventory purposes. Mil'kov's landscape classification, given above, is more useful for inventory purposes but has too few subdivisions. Likewise, a classification of land-use types, such as that devised by Stamp for the Land Utilisation Survey of Britain in the 1930s, places too much stress on agricultural land use (Stamp 1931, p. 45). In fact, a classification should be developed to suit the basic types of landscapes observable in a given region. For example, if a region contains no urban settlements, but has a landscape of dispersed farms distributed along rural roads laid out according to the rectangular survey system and adjacent to an area with line settlement along a river and long-lot fields (for example, the Raisin River area west of Monroe, Michigan), then special landscape classes must be devised. Aerial photographs should be used to clarify the nature of the landscape components and aid in their identification.

In the case of a landscape region such as that described above, the fields and farms associated with the long-lot system will probably be of greater historical interest than those associated with the rectangular survey system and thus require special recognition. Large farm-building complexes may belong to modern agricultural enterprises, such as corporate farms, and would thus be of little historical interest. The design of the classification system for the region and the interpretation of the basic landscape patterns should therefore be performed by a cultural geographer with some knowledge of local conditions. A classification for the above region might be (1) isolated farmhouse with less than three barns and other structures, (2) isolated farmhouse with three or more barns and other structures, (3) farmhouse and buildings forming component of line settlement, (4) other buildings, (5) fields of the rectangular survey system, (6) long-lot fields, (7) woodlots, (8) water bodies. These classes can be identified by a letter or number written on an overlay or on the map itself, on or beside the map symbols. The information can then be summarized in a written report attached to each map sheet.

In the case of an urban area, the classification system will reflect the aim of the planned conservation. A simple code may identify areas of no immediate interest to the planners, such as modern suburbs or industrial areas, and a more complex one may be devised to indicate areas of the historic center of the town. With the aid of aerial photographs the size, height, and type of buildings can be established and indicated on a town plan or overlay.

Once a preliminary survey of the various landscape components is made, a number of photographs should be taken in the field. These photographs have two purposes: to obtain views of the main types of landscape identified in the region and to identify and clarify the nature and appearance of houses, buildings, and other structures observed on the maps and aerial photographs but not adequately identified. Depending on the size of the study region, one or two photographers should be able to complete this task in a day or two.

The composition of the evaluation team can only be decided upon when this preliminary survey is completed. The nature of the landscape components will determine what type of specialists will be required to evaluate them and whether the participation of representatives of the public or other interested groups will be necessary. If a number of buildings of possible historical interest or architectural value have been identified, the specialists, aided by the information recorded on the maps and the ground photographs, will make inventories in the field of of landscape components recommended for conservation. Their recommendations may range from the conservation of entire rural landscapes or sections of towns to groups of buildings or individual structures, or it may involve relocation of buildings. This information can also be plotted on the survey maps as well as being recorded in written reports. In the case of buildings or other features recommended for preservation, a note can be attached to a photograph indicating age, present use, number of stories, building material of walls, types of windows and doors, type and material of roof, other details, and any repairs required. This inventory system has been used in Sweden (Persson 1976, pp. 20-25).

If the evaluation of the landscape involves any aesthetic judgment, then representatives of the public should be involved. A number of selected photographs should be shown to a group of people, who would be asked to rank them. The technique advocated by Fines and described above can be utilized, substituting the judgment of the public for that of a group trained in a design discipline. This judgment will, of course, be subjective in nature, and in the case of a landscape where there are many components of historic as opposed to aesthetic value, the public's views will be of less importance. The whole question of the public versus experts in the question of landscape evaluation is a difficult one to resolve, and no hard and fast rules can be laid down. Each case must be, to a great extent, decided on its own merits.

The problem is perhaps most acute in the evaluation of townscapes. In the case of American cities many members of the public have become inured to urban blight and have little idea of what constitutes a more desirable townscape. Thus, their views may be unreliable, and a real case can be made for their reeducation by persons with a better knowledge of the aesthetics of the urban landscape. The series of urban "environmental assessments" made by Lowenthal and others in New York City, Boston, Cambridge, Columbus, Ohio, and other cities were an interesting experiment in obtaining public reaction to townscapes. In New York City six city walks of about a half-mile in length were selected; and sixty-six persons recruited from an architectural firm, a hospital nursing staff, and a city college were asked to record their impressions on a specially designed questionnaire (Lowenthal and Riel 1972, pp. 2, 31-32). The Columbus study used men taking a fine arts course at Ohio State University and a local women's club (Lowenthal 1972, p. 2). The aim of the studies was to assess the general impression of the cities and to analyze the environmental preferences of the observers. As in other studies involving subjective judgments, the attitudes of the different groups varied. In the case of New York, for example, the nurses were more enthusiastic about the city than the college students (Lowenthal and Riel 1972, p. 23). The problem of the selection of representative observers is still one of the most difficult to resolve, but some degree of mixing is desirable. Some modification of Lowenthal's method can be utilized to insure public participation in an urban landscape evaluation study.

After the views of the evaluation teams have been recorded, a decision must be made on the priorities to be allocated to the areas or components of the landscape recommended for preservation. A system can be devised in which the numerical values allotted by the specialists to the various elements of the landscape can be added to those of the general public along the lines developed in several of the studies discussed above. However, the ultimate decisions must be made after taking into account other factors, such as the number of tourists and others who are likely to visit the region, the local transportation network, and the competition of other forms of land use.

The evaluation of the cultural landscape is a subject which requires further study by geographers. As urban and industrial expansion into rural areas increases and as the old historic centers of cities are torn down to suit the demands of growing traffic, the practical problem of assessing the value of landscapes and ensuring their conservation is becoming more urgent each day.

## *REFERENCES CITED*

Blacksell, Mark and Andrew W. Gilg. "Landscape Evaluation in Practice: The Case of South-East Devon." *Transactions of the Institute of British Geographers* 66 (November 1975) :135-40.

Brancher, D. M. "Critique of K. D. Fines: Landscape Evaluation." *Regional Studies* 3 (April 1969) :91-92.

Burke, Gerald. *Townscapes.* Harmondsworth: Pelican Books, 1976.

Clark, S. B. K. "Landscape Survey and Analysis on a National Basis." *Planning Outlook* 4 (1968) :15-29.

Clout, Hugh D. *Rural Geography: An Introductory Survey.* Oxford: Pergamon Press, 1972.

Craik, K. H. "Psychological Factors in Landscape Appraisal." *Environmental Behaviour* 4 (1972) :255-66.

Fines, K. D. "Landscape Evaluation: A Research Project in East Sussex." *Regional Studies* 2 (September 1968) :41-55.

Gilg, Andrew W. "Assessing Scenery as a Natural Resource: Causes of Variation in Linton's Method." *Scottish Geographical Magazine* 92 (April 1976) :41-49.

Great Britain, Central Office of Information. *Town and Country Planning in Britain.* Reference Pamphlet no. 9. London: H. M. Stationery Office, 1972.

Hoskins, W. G. *The Making of the English Landscape.* London: Hodder and Stoughton, 1955.

Lambert, Audrey M. *The Making of the Dutch Landscape.* New York: Seminar Press, 1971.

Leopold, L. B. "Quantitative Comparisons of Some Aesthetic Factors Among Rivers." U.S. Geological Survey Circular no. 620. Washington, D. C., 1969.

Lewis, Peirce F. David Lowenthal, and Yi-Fu Tuan, eds. *Visual Blight in America.* Commission on College Geography Resource Paper no. 34. Washington D. C.: Association of American Geographers, 1973.

Linton, David L. "The Assessment of Scenery as a Natural Resource." *Scottish Geographical Magazine* 84 (December 1968) :219-38.

Lowenthal, David. "Not Every Prospect Pleases: What Is Our Criterion for Scenic Beauty?" *Landscape* 12 (Winter 1962-63) :19-26.

______. "The American Scene." *Geographical Review* 58 (January 1968) :61-88.

______. *Environmental Assessment: A Case Study of Columbus, Ohio.* Publications in Environmental Perception no. 4. New York: American Geographical Society, 1972.

Lowenthal, David and Hugh C. Prince. "The English Landscape." *Geographical Review* 54 (July 1964) :309-46.

______. "English Landscape Tastes." *Geographical Review* 55 (April 1965) :186-222.

Lowenthal, David and Marquita Riel. *Environmental Assessment: A Case Study of New York City.* Publications in Environmental Perception no. 1. New York: American Geographical Society, 1972.

Meinig, Donald W. "Environmental Appreciation: Localities as a Humane Art." *Western Humanities Review* 25 (Winter 1971) :1-11.

Mil'kov, F. N. *Cheloveki Landshafty* (Man and Landscapes). Moscow: Mysl', 1973.

Morisawa, M. "Evaluating Riverscapes." In Donald R. Coates, ed., *Environmental Geomorphology and Landscape Conservation,* pp. 91-106. Stroudsburg: Dowden, Hutchinson, and Ross, 1971.

Morris, A. E. J. "Four Towns in a Bohemian Setting." *Geographical Magazine* 45 (August 1973) :814-19.

Newcomb, Robert M. "Geographic Aspects of the Planned Preservation of Visible History in Denmark." *Annals of the Association of American Geographers* 57 (September 1967) :462-80.

Orme, A. R. *Ireland.* Chicago: Aldine, 1970.

Persson, Claes, "En 'bevarandeplan' bakgrund, uppbyggnad och genomförande" (A "Preservation Plan" Background, Development and Realization). *Byggnadsvård och Landskap.* Ymer 1975. Stockholm: Svenska Sällskapet for Antropologi och Geografi, 1976.

Peters, Gary L. and Burton L. Anderson. "Industrial Landscapes: Past Views and Stages of Recognition." *Professional Geographer* 28 (November 1976) :341-48.

Roorda van Eysinga, N. P. H. J. "Toelichting op het onderzoek naar het landschap in het Stadsgewest" (Information About the Research on the Landscape of the Region Around the City). *Noord-Brabant* 13 (1969) :31-36.

Stamp, L. Dudley. "The Land Utilization Survey of Britain." *Geographical Journal* 78 (July 1931) :40-53.

Unwin, K. I. "The Relationship of Observer and Landscape in Landscape Evaluation." *Transactions of Institute of British Geographers* 66 (November 1975) :130-34.

Visscher, H. A. *Het Nederlandse landschap: een typologie ten behoeve van het milieubeheer* (The Dutch Landscape: A Typology for Environmental Protection). Utrecht: Het Spectrum, 1972.

Weddle, A. E. "Techniques in Landscape Planning." *Journal of the Town Planning Institute* 55 (1969) :387-89.

## *Recreational Geography: Its Evolution and Application to Problems of Wilderness Management*

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As one reviews the various themes of geography's rich history, concern with the relationship of people to their environment is central. Historically, the study of mankind as related to environment has dominated the discipline, and geographers from Ratzel to Sauer to Tuan have focused their attention on this relationship (Hewitt and Hare 1973, p. 1). The result has been a diversity of alternative, often conflicting perspectives yet one joined by a common interest in how society perceives, behaves within, and utilizes its surroundings. It is somewhat ironic, then, that at a time when the holistic perspective required for the study of society and environment was most crucial, geography, in its anxiousness to cast off the disreputable theories of environmental determinism, nearly rejected the continued study of environmental influences on human behavior.

Today we seem to be regaining a more balanced perspective about the relationship between society and environment. Simple notions of causation have been replaced by more realistic theories of complex interaction and influence between human behavior and the physical environment. In particular, we see an increasing emphasis on understanding how and why people perceive the environment as they do and how these perceptions, whether grounded in reality or myth, alter the pattern of occupance and use of that environment. For example, the substantive body of knowledge concerning the perception of natural hazards is replete with cases of how the image of landscapes, as modified by the cognitive processes within the beholder, influences human settlement.

Within the broad domain of man-environment studies there has been increasing interest in the study of landscape as a setting for man's leisure-time behavior. Geographic interest in this sphere of human activity is probably a result of many things, but it is almost certainly related to the magnitude of impact associated with leisure and, more specifically, outdoor recreation activity. Whether considered as a land use, economic activity, or component of human behavior, outdoor recreation has grown substantially in the past three decades. Increases in mobility, education level, discretionary income, and leisure time have all been cited as factors influencing the rise in outdoor recreation participation (Clawson and Knetsch 1966). There has also been a heightened appreciation of the environment as a source of recreation, scenic, and amenity values (for example, see Ullman 1954). As a result of these and other factors, outdoor recreation has taken on the accoutrements of many other activities that merit the attention of geographers: governmental institutions that promote its development (Bureau of Outdoor Recreation); formal funding programs (Land and Water Conservation Fund); university and special educational programs to train experts; specialized literature *(Journal of Leisure Research);* and a host of citizen and professional groups to promote special interests within the outdoor recreation sphere (National Recreation and Park Association, Sierra Club). In a very real sense, outdoor recreation has acquired an aura of legitimacy. Of particular interest with regard to the focus of this paper, outdoor recreation has become an increasingly significant focus for geographers. But this has not always been the case, and it is perhaps instructive to review briefly the origins of recreational geography and the evolution to its present status.

## *RECREATIONAL GEOGRAPHY: A REVIEW*

Systematic investigations of recreation as a phenomena for geographic study largely originated in the 1930s. The work was descriptive and often concerned with the economic significance of recreation. For example, Brown's (1935) review of recreational geography primarily addressed the issue of tourism and called for increased attention by geographers to the economic consequence of tourism development. Studies by McMurry (1930), Prophet (1936), Greeley (1942), and Deasy (1949) were important contributions to our increased understanding of the recreational character of various settings. The nature of the research on recreation retained its economic orientation throughout the 1940s and 50s, with the exception of such work as Booth's (1948) analyzing the characteristics of recreational resources in eastern Washington and Wolfe's (1951) study investigating the origins of second-home owners. But the general flavor of recreational geography prior to the 1960s was an economic one, and this is clearly reflected in the description of the status of recreational geography as outlined in *American Geography: Inventory and Prospect* (1954), in which it was positioned as a subcomponent of economic geography. Empirically it was a justifiable placement, both because most of the literature dealt with the economic dimensions of recreation and, as Murphy (1963, p. 33) noted, because recreation was one of the major economic activity sectors in many states and countries.

The relatively narrow focus of recreational geography, particularly the traditional emphasis on the economic dimensions of recreation, was criticized in a comprehensive review of the field by Wolfe in 1964. Wolfe also took exception to what he saw as the generally inadequate amount of scholarly attention given recreation. The burgeoning growth of recreation and its consequent impact on communities, resources, and people necessitated an increasingly sophisticated level of attention from geographers. Wolfe strongly supported Murphy's (1963, pp. 33-34) earlier call for an accelerated program of research, both in the universities and in the various governmental bodies with responsibilities for the management of recreation resources.

It is not easy to determine the extent to which geography has responded to the need for research on outdoor recreation. For example, an examination of professional geographic literature shows that studies of outdoor recreation comprise a very small proportion of the total articles published. In Table 1, the number of articles dealing specifically with recreation between 1965 and 1976 from the *Annals, Professional Geographer, Geographical Review,* and *Canadian Geographer* are presented.

Clearly, the topic of outdoor recreation has been limited in the professional geographic literature. At the same time, it would be incorrect to conclude that a lack of interest or participation exists on the part of geographers in the outdoor recreation field. This conclusion is supported by the following.

First, Table 1 shows only those articles specifically focused on outdoor recreation or tourism. There are many other articles in which outdoor recreation is discussed. For instance, Steiner's (1966) analysis of available public land in southern California has direct implications for the recreation geographer as do Lowenthal's (1968) fascinating discussion of landscape quality in the United States and Pryde's (1976) analysis of landscape conservation zones around residential areas.

Table 1—NUMBER OF RECREATION-RELATED ARTICLES IN SELECTED GEOGRAPHICAL JOURNALS, 1965-1976

| Annals | Professional Geographer | Geographical Review | Canadian Geographer |
|---|---|---|---|
| 3 | 5 | 5 | 6 |

Source: Based on listings from table of contents.
*Covers issues only from 1966 to 1976.

Second, a number of useful literature reviews dealing with man-environment relationships have been published in the past decade. Many of these cite important work on outdoor recreation, either done by other geographers or of direct interest to geographers. Significant reviews that merit attention are those by Chappelle and Andress (1967), Tuan (1972) and Svart (1976).

Third, outdoor recreation continues to be a major research focus for some faculty and graduate students. Early assessments of geographical interest in outdoor recreation noted the relatively high level of investigation given outdoor recreation by graduate students (Briere 1962 and Wolfe 1964), and this situation appears still to be the case. A recent bibliography of theses and dissertations on recreational geography by Travis (1972) lists more than 200 entries from

American and Canadian universities. A review of theses and dissertations listed in the annual compilation published in *The Professional Geographer* includes 145 titles, about 3 percent of the total. As noted above, however, many other theses and dissertations probably contain discussions of recreational geography that are not reflected in their titles.

It is also apparent from a review of theses and dissertations that recreation geography has been substantially "liberated from the thralldom of economic geography" that Wolfe called for in 1964. As Table 2 indicates, a diverse range of subjects now command attention from recreational geographers, with economic orientations relegated to a minor role.

Table 2—MAJOR THEMES IN THESES AND DISSERTATIONS IN RECREATIONAL GEOGRAPHY, 1971-1976.

| Subject | Number of Theses and Dissertations (%) |
|---|---|
| Development of recreation resource inventory systems | 22 (15%) |
| Perception of recreation landscapes | 21 (15%) |
| Analysis of recreationists' spatial behavior | 44 (31%) |
| Investigations of physical-biological impact | 10 (7%) |
| Economic impact of recreation | 8 (6%) |
| Tourism | 14 (10%) |
| Other miscellaneous topics | 23 (16%) |

Source: Annual lists of theses and dissertations, *Professional Geographer*, 1971-1976.

Geographers also have played an important role in helping identify recreation as a significant research area for scientific investigation. Several specific research areas for geographic investigation are identified in the National Academy of Sciences report *A Program for Outdoor Recreation Research* (1969), largely because of input from such people as Edward Ackerman and Roy Wolfe.

Many geographers claim recreation as a major research interest. The editorial board of the *Journal of Leisure Research* and the newly published *Leisure Sciences* both include geographers, commonly more than one. In the 1974 Directory of AAG Members, more than 300 members listed recreational geography as one of their three specialty areas. Interest in the field is sufficient to warrant publication of a newsletter, *Recreation, Tourism and Sport.*

Finally, we must recognize that much of the contribution of geographers to recreation management, planning, and research is not evident in the professional geographic literature. The reasons for this would seem to relate closely to the general focus of this volume; that is, much of the geographer's involvement in outdoor recreation has an applied aspect to it that has been reported in literature other than the professional geographic outlets, if published at all. For example, the *Journal of Leisure Research* has provided a professional forum for the study of leisure behavior that many geographers have utilized. Since publication began in 1969, slightly over 10 percent of the articles have been authored or coauthored by geographers, a significant figure given the number of disciplines involved in recreation research. Other outlets, such as agricultural experiment station reports, government publications, reports to contracting agencies, and unpublished reports must be searched in order accurately to assess geographic involvement in outdoor recreation management, planning, and research.

The growing involvement of geographers in outdoor recreation is further reflected by the recent publication of two books on the geography of recreation: Cosgrove and Jackson's *The Geography of Recreation and Leisure* (1972) and Lavery's *Recreational Geography* (1974). Although both draw heavily from research and management experience in the United Kingdom, North American examples are given and further illustrate the breadth of geographic involvement in recreation. Recreational geography has enjoyed an important role in Europe (Wolfe 1964, p. 226) as well as Canada, more so, it seems to me, than in the United States.

Geographers have established themselves in the outdoor recreation management and research field in a number of ways. University research reflects only part of the total level of involvement by geographers. The application of geographic theories, methods, and concepts in recreation management, planning, and research is probably used most frequently by individuals holding baccalaureate or master's degrees in geography and employed at federal, state, or local governmental levels. The generally depressed nature of the job market over the past five years has probably limited the geographer's role. But important work on applied recreational geography has been done. For example, geographers played a major part in the preparation of portions of the landmark Outdoor Recreation Resource Review Commission reports. Geographers continue to make significant contributions in organizations such as the Bureau of Outdoor Recreation, National Park Service, state park and recreation departments, and local government recreation offices. While a complete inventory of work by geographers is not possible to compile at this time, a few selected examples will illustrate some of their important contributions.

The inventory and classification of recreation resources is an issue that a number of geographers have examined. Knowledge about the amount, characteristic, and potential of resource systems for alternative uses, including recreation, is a major need for decision makers today. It is often one of the major information deficiencies, however. In Minnesota an impressive series of studies prepared under the direction of geographers has provided state authorities with a comprehensive quantitative profile of the state's recreation potential. For example, an analysis of developable land in northern Minnesota identified the existence of more than 300,000 acres of privately owned land near the newly created Voyageur's National Park and provided an assessment of potential impacts on these lands stemming from park development (Rusch, Borchert, and Orning 1972).

The spatial behavior of recreationists and their use patterns at recreational sites are other subjects geographers have examined. The former has drawn considerable sophisticated analysis. In Canada Wolfe (1967) developed a theoretical framework to predict and describe recreational traffic behavior along rural highways. Analyses of recreational demand in Michigan, using various travel models, have also drawn the attention of geographers (Milstein and Reid 1966). At the micro-scale, Lime (1971, 1972) investigaged how recreationists' perceptions influenced their choices of campgrounds in the Superior National Forest. Campground occupancy rates varied from in excess of 100 percent to 12 percent on a seasonal basis, and the basic question addressed concerned the reasons for the extraordinarily skewed use distributions. Factors such as available opportunities, knowledge of alternatives, level of use, and campground size affected the decisions of users. Perhaps the fact that visitors perceived recreational environments quite differently than did recreation managers is of major significance. Desirable locations, as defined by managers, were quite different from sites judged high in quality by managers. This finding coincides closely with studies by Lucas (1964) concerning visitor perceptions of wilderness and with user assessments of desirable campground characteristics contrasted with managerial judgments (Lucas 1970). For instance, Lucas (1970, p. 9-10) found that two-thirds of the visitors rated beach quality and overall site quality higher than did managers, while two-thirds rated fishing quality as lower than did managers. The implication seems clear that the differential perception of resource quality makes quasi-objective quality ratings of doubtful utility. Measures founded on objective, straightforward accounts of resource conditions (yards of beach, acres of tree cover, and so forth) seem much more useful (Orning and Maki 1972, p. 57).

Applications of physical geography to problems of recreation management can also be cited. It is the composition and diversity of physical-biological elements that give most areas their recreation potential; and, in turn, resulting patterns, densities, and styles of recreation use alter those physical resources in ways that are of interest and concern to geographers as well as resource managers. Studies by Dykema (1971) of the spatial patterns of ecological impact resulting from camping in the southern Sierra Nevada revealed several important relationships between use and impact. For example, she found important variations in the nature and level of observed impacts between the various life zones in the southern Sierra. Also, the varying sensitivity of life zones to camper impact apparently accounted for the lack of association between impact and accessibility, with those life zones most accessible to use also the most resistant to impact. She also documented that impact was highly variable within individual camps, with certain features such as attractions, camp entrances, and restrooms receiving most of the impact. The implications of such a finding for campground design seem clear.

The potential contribution of geographic perspectives and techniques to recreation problems is great. To focus more specifically on some examples of application, the remainder of this paper will describe some of the geographic analyses done on the recreation use of wilderness and other dispersed recreation settings.

## *GEOGRAPHIC ANALYSES OF WILDERNESS RECREATION USE*

The U.S. Forest Service supports a program of recreation research across the country. Currently it is staffed by about eighteen scientists, five of whom are geographers. The program is organized on a topical basis, with each of the nine units responsible for a particular problem area. For example, the unit at Missoula, Montana, staffed by Bob Lucas (a University of Minnesota Ph.D. in geography) and myself, has the responsibility for research on recreation use of wilderness and other undeveloped lands. This mission is nationwide, and not restricted to lands administered only by the U.S. Forest Service.

"Wilderness" is a term with many meanings (Nash 1973), but since 1964, when the Wilderness Act (PL 88-577) passed, it has acquired a relatively precise legal definition. Such lands are to be undeveloped, representative examples of pristine ecosystems, lands where, as the poetic phrasing of the Act notes, "the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." The National Wilderness Preservation System created by the Wilderness Act contains land administered by the U.S. Forest Service, National Park Service, and Fish and Wildlife Service; and as a result of legislation passed in 1976, it will soon contain lands of the Bureau of Land Management. Currently 14.4 million acres are in the System, but only about 12 percent of this acreage is located east of the 100th meridian.

Our program of wilderness research centers on three general problem areas, each with a definite geographic thrust. First, we are concerned with developing an accurate picture of use: how much, what kinds, its distribution within and among areas, and how it is changing. Second, we are studying how variations in resource and use conditions affect the quality of experiences people derive from visiting wilderness. Here, there is interest in how such things as use levels affect perceived satisfaction and travel patterns. Third, and a much more specific issue, we have initiated studies on how use distributions can be modified. The role of external access, interior trail systems, and management actions (for example, providing visitors with information) are involved in this research.

The research programs also have dealt with other studies (for example, economic analyses of the opportunity costs of wilderness designation, citizen participation in decision making, water-quality studies), but the three categories described previously represent the major components of our program. A number of specific studies have been conducted within these broad problem areas.

### *Problems of Use Measurement*

One of the major problems affecting recreation studies has been the lack of accurate data about the recreation phenomenon (Wolfe 1964). Even though a substantial amount of work has been done on the issue, it still remains a major handicap. This is particularly true in wilderness where use is widely dispersed, of low intensity, and highly mobile. Information about use typically has been obtained through such techniques as trail registers, but they have not been particularly successful. At best, they might obtain 60-70 percent registration, but studies (Lucas 1975) indicate that these rates can drop below 30 percent. Moreover, there are systematic differences in the rates at which different kinds of users register (hikers versus horseback groups, day use versus overnight) (Lucas, Schroeder, and James 1971). Thus, the baseline data fundamental to many management decisions and research questions are simply lacking.

Understanding use distributions is, as one might expect from the above discussion, extremely difficult. But some relatively clear facts are emerging. For instance, use distributions, at access points, within areas, and between areas are highly skewed. For example, in the Boundary Waters Canoe Area in northern Minnesota, 10 percent of the area's access points receive 70 percent of the use. This pattern has been found in all areas studied to date.

Internal distributions are also highly skewed. For example, we have developed a measure of use concentration to reflect the relative share of use that a given proportion of trail mileage carries. What we find is that small percentages of trail mileage receive the preponderant share of use. In the Spanish Peaks Primitive Area in Montana, only 10 percent of the trail system accounts for 52 percent of all use; in many other areas, the percentage of use is even higher (Lucas 1974, p. 11). In the Boundary Waters Canoe Area visitors to some lakes encountered more than forty times as many groups during the same time period as did visitors to other areas only a portage or two away (Stankey, Lucas, and Lime 1976, p. 40)

At the macro-scale, the same uneven distribution can be found. For the National Wilderness Preservation System as a whole, use intensities vary enormously, from more than four visitor-days per acre to only .01 visitor-days per acre (a visitor-day is an aggregate stay of twelve hours by an individual).

This uneven distribution leads to a number of important management questions. Problems of congestion are increased, resource impacts are often accentuated, and the kinds of objectives set forth for wilderness are seriously threatened. However, simply knowing the pattern of these distributions is a basic first step to implementing management programs and research activities that might eventually alleviate such problems.

### *Measuring Wilderness Use Capacity*

The issue of recreational carrying capacity has been of interest to geographers for some time (for example, see Chubb 1964; Lucas 1964; and Tivy 1972). The subject has two relatively distinct components: (1) physical-biological capacity and (2) social-psychological capacity. The latter emphasis is a sub-issue of the broader geographic concern with understanding how perception alters the use of the environment, and most of our work has dealt with this aspect of capacity as opposed to studies of physical-biological capacity, although other geographers are examining this aspect of carrying capacity (Cole 1977).

Our studies have revealed a number of important aspects of the capacity question. Visitor responses suggest a preference for relatively low contact levels and the existence of significant conflicts based on differing travel methods, party sizes, and behavior perceived as inappropriate. There are significant variations in the extent to which contact with other groups cause a loss in satisfaction, however, depending on where the contacts occur. For example, most visitors perceive that the wilderness is composed of at least two macro-zones—a peripheral zone where contact levels are to be anticipated and an interior zone, where use intensities should be low. In the peripheral zone, visitor anticipation of higher interparty contact results in a degree of tolerance to conditions that are perceived as crowded in the interior zone (Stankey 1973).

There is also a micro-scale spatial component to the capacity problem. In areas of overnight camping (for example, along lake shores) visitor desires for some degree of isolation and solitude result in an expressed preference for camping out of sight and sound of others. Thus, density levels that are low enough generally to allow visitors to find campsites apart from others seem important to maintain. We have also found that visitor reaction to encounter varies within the interior depending on whether the contacts occur along trails or at campsites.

### *Problems of Modifying Use Distributions*

Our third problem area concerns developing techniques and methods whereby current use distributions might be altered so as to achieve more even distributions. As discussed above, virtually all areas studied have been characterized by intense concentrations of use in a relatively few areas. As a result, problems of congestion and crowding are intensified as are problems of resource degradation. When considered in the context of an area where the management objectives call for maintenance of qualities such as solitude and naturalness, these problems become particularly severe. While it would be possible to gain some control over these problems through such techniques as rationing (as has been done in a few locations) or direct control of users (prescribing where to go, when to camp, how long to stay), we believe less regimenting measures might be instituted that could achieve the same results. Certainly one possible action is achieving more even use distributions. But how?

One apparent solution lies in providing visitors with more accurate information about the wilderness—about travel conditions, attractions, use levels, and alternative opportunities. For example, in one study currently being completed, we provided visitors with a brochure describing one portion of the Selway-Bitterroot Wilderness in Montana. The brochure contains a map of the area with information on how to reach alternative trailheads (a particular problem here because of private land along the wilderness boundary), areas of forage for recreational livestock, trail conditions, and so forth. In addition, based on information about the previous year's use, we prepared a bar graph showing the relative proportion of users entering the area through the various trailheads. Thus, people concerned with solitude have an opportunity to select an entry point where use might be lower. Although this study has not yet been completed, tentative analysis suggests some positive effects on visitor behavior. One important finding already discovered is that information must reach people early in the planning stages to affect their decision of where to go.

The use distribution problem may be analyzed by computer simulation. Cooperative work between ourselves, Resources for the Future, Inc., and IBM has resulted in development of an operational wilderness travel simulation model. The model allows for quite realistic simulation of actual wilderness travel behavior. For example, it permits simulating variation in use level, route of travel, party size, method of travel, entry point, and several other aspects of travel behavior. It records encounter levels on a fairly site-specific basis and allows managers and researchers to review the consequences of alternative management actions prior to implementation of a policy. Because information on use distributions and amount and type of use is given, potential physical-biological impacts can also be anticipated and reviewed concerning their acceptability.

Data for development of the model was acquired largely from map-diaries provided visitors in the Desolation Wilderness in California. These provided information on where people went, length of time required to travel certain trail segments, places people stopped to view attractions or campsites, and so forth. These data were in turn field checked. Simulation runs of the "base case" or the period for which data were collected revealed a fairly high level of similarity between simulated conditions and self-report measures in such things as level of use contacted. Discussions of the general properties of the model can be found in Lucas and Shecter (1976); the theoretical aspects of the model are described in Smith and Krutilla (1976); and the computer program and program directions are in Shecter (1975).

## *CONCLUSION*

It seems clear that geography is relevant to the fields of outdoor recreation management, planning, and research. The movement of people over space in search of recreation; their perception and use of recreational resources; and the various physical, biological, economic, and social impacts associated with use of resources all represent problem areas to which geographer can apply their skills.

It has been our experience that recreation administrators, managers, and planners are interested in what geography has to offer. Although it is often difficult to trace the impacts of research on policy formulation, it is clear that studies by ourselves and others have gradually affected various outdoor recreation policies and programs. For example, the wilderness travel simulation was used to test a series of potential management alternatives in the Desolation Wilderness, and decisions regarding trail development and appropriate use levels were founded on the results. As another example, the documented impact of large party size on both resources and experiences established in studies of how visitors perceive the wilderness resource has led to a general limiting of party size by resource managers and private organizations.

In applied geography a major focus ought to be on the development of information of direct policy relevance. Research should involve problems that are important to decision makers. It should be recognized that the analysis of policy variables and the investigation of priority problems within realistic frameworks are most useful to those people in our society charged with decision-making authority (Morrison 1966). Geography, with its regional perspective; its interest in social, economic, and physical phenomena in space; and its integrating style of analysis seems particularly well suited to providing this type of assistance.

## *REFERENCES CITED*

Booth, A. W. "The Lakes of the Northeastern Inland Empire: A Study of Recreational Sites." Bureau of Economics and Research Bulletin no. 5, Pullman, Wash., 1948.

Briere, Roger. "Esquisse bibliographique de geographic touristique." *Revue Canadienne de Geographic* 16 (1962) :57-68.

Brown, R. M. "The Business of Recreation." *The Geographical Review* 25 (1935) :467-75.

Chappelle, John E., Jr. and Joel M. Andress. "A Geography of Man and Environment." *The Professional Geographer* 19 (1967) :336-42.

Chubb, Michael. "Outdoor Recreation Land Capacity: Concepts, Usage, and Definitions." Master's thesis, Michigan State University, Department of Resource Development, 1964.

Clawson, Marion and Jack L. Knetsch. *Economics of Outdoor Recreation.* Baltimore: The Johns Hopkins University Press, 1966.

Cole, David N. "Man's Impact on Wilderness Vegetation: An Example from Eagle Cap Wilderness, Northeastern Oregon." Ph.D. dissertation, University of Oregon, Department of Geography, 1977.

Cosgrove, Isobel and Richard Jackson. *The Geography of Recreation and Leisure.* London: Hutchinson University Library, 1972.

Deasy, G. F. "The Tourist Industry of a 'North Woods' Country." *Economic Geography* 25 (1949) :240-49.

Dykema, Jean Anne. "Ecological Impact of Camping upon the Southern Sierra Nevada." Ph.D. dissertation, University of California at Los Angeles, Department of Geography, 1971.

Greeley, R. B. "Part-time Farming and Recreational Land Use in New England." *Economic Geography* 18 (1942) :145-52.

Hewitt, Kenneth and F. Kenneth Hare. "Man and Environment: Conceptual Frameworks." Commission on College Geography Resource Paper no. 20. Washington, D.C.: Association of American Geographers, 1973.

Lavery, Patrick. *Recreational Geography.* London: David and Charles, 1974.

Lime, David W. "Factors Influencing Campground Use in the Superior National Forest of Minnesota." USDA Forest Service Research Paper NC-60, 1971.

_____. "Behavioral Research in Outdoor Recreation Management: An Example of How Visitors Select Campgrounds." In Joachim F. Wohlwill and Daniel H. Carson, eds., *Environment and the Social Sciences: Perspectives and Applications*, pp. 198-206. Washington, D.C.: American Psychological Association, 1972.

Lowenthal, David. "The American Scene." *The Geographical Review* 58 (1968) :61-88.

Lucas, Robert C. "The Recreational Capacity of the Quetico-Superior Area." USDA Forest Service Research Paper LS-15, 1964.

_____. "User Evaluation of Campgrounds on Two Michigan National Forests." USDA Forest Research Paper NC-44, 1970.

_____. "Forest Service Wilderness Research in the Rockies: What We've Learned So Far." *Western Wildlands* 1 (January 1974) :5-12.

_____. "Low Compliance at Unmanned Trail Registers." USDA Forest Service Research Note INT-200, 1975.

Lucas, Robert C., Hans T. Schroeder, and George A. James. "Wilderness Use Estimation: A Pilot Test of Sampling Procedures on the Mission Mountains Primitive Area." USDA Forest Service Research Paper INT-109, 1971.

Lucas, Robert C. and Mordecai Shecter. "A Recreational Visitor Travel Simulation Model as an Aid to Management Planning." Paper presented to the XVI*th* World Congress of the International Union of Forestry Research Organizations, Oslo, Norway, June 1976.

McMurry, K. C. "The Use of Land for Recreation." *Annals of the Association of American Geographers* 20 (1930) :7-20.

_____. "Recreational Geography." In Preston E. James and Clarence F. Jones, eds., *American Geography: Inventory and Prospect.* New York: Syracuse University Press, 1954.

Milstein, David N. and Leslie M. Reid. *Michigan Outdoor Recreation Demand Study, Vol. 1.* Michigan Department of Conservation, Technical Report no. 6, 1966.

Morrison, Charles C., Jr. "A National Survey of Outdoor Recreation Participation and Preferences." Paper presented at the Annual Meeting of the Association of American Geographers, Toronto, Canada, August 1966.

Murphy, Richard E. "Geography and Outdoor Recreation: An Opportunity and an Obligation." *The Professional Geographer* 15 (1963) :33-34.

Nash, Roderick. *Wilderness and the American Mind.* 2nd ed. New Haven: Yale University Press, 1973.

National Academy of Science. *A Program for Outdoor Recreation Research.* NAS Publication 1727, 1969.

Orning, George W. and Les Maki. "Land Management Information in Northwest Minnesota: The Beginning of a Statewide System." Minnesota Land Management Information System Study, Report no. 1, 1972.

Outdoor Recreation Resources Review Commission. *Water for Recreation—Values and Opportunities.* Study Report 10. Washington, D.C.: U.S. Government Printing Office, 1962.

Prophet, E. C. "Some Types of Recreational Land Use in Michigan. *Papers of the Michigan Academy of Science, Arts and Letters* 22 (1936) :385-95.

Pryde, Philip R. "The Residential-Landscape Conservation Zone as an Example of Applied Geography." *The Geographical Review* 66 (1976) :200-08.

Rusch, Pamela G., John R. Borchert, and George W. Orning. "Land for Development Adjoining Northern Minnesota's National Recreational Corridor." Minnesota Land Management Information System Study, Report no. 2, 1972.

Shecter, Mordechai. "Simulation Model of Wilderness-Area Use: Model-User's Manual and Program Documentation." Washington, D.C.: Resources for the Future, Inc., 1975.

Smith, V. Kerry and John V. Krutilla. *Structures and Properties of a Wilderness Travel Simulator.* Baltimore: The Johns Hopkins University Press, 1976.

Stankey, George H. "Visitor Perception of Wilderness Recreation Carrying Capacity." USDA Forest Service Research Paper INT-142, 1973.

Stankey, George H., Robert C. Lucas, and David W. Lime. "Crowding in Parks and Wilderness." *Design and Environment* 7 (Fall 1976) :38-41.

Steiner, Rodney. "Reserved Lands and the Supply of Space for the Southern California Metropolis." *The Geographical Review* 56 (1966) :344-362.

Svart, Larry M. "Environmental Preference Migration: A Review." *The Geographical Review* 66 (1976) :314-30.

Tivy, Joy. "The Concept and Determination of Carrying Capacity for Recreational Land in the U.S.A." Countryside Commission for Scotland, Occasional Paper no. 3, 1972.

Travis, Richard W. "The Spatial Organization of Recreation: A Bibliography of Theses and Dissertations on the Geography of Recreation." Council of Planning Librarians, Exchange Bibliography no. 350, 1972.

Tuan, Yi-Fu. "Environmental Psychology: A Review." *The Geographical Review* 62 (1972) : 245-56.

Ullman, Edward L. "Amenities as a Factor in Regional Growth." *The Geographical Review* 44 (1954) :119-32.

Wolfe, R. I. "Summer Cottagers in Ontario." *Economic Geography* 27 (1951) :10-32.

———. "Perspective on Outdoor Recreation: A Bibliographical Survey." *The Geographical Review* 54 (1964) :203-38.

———. "A Theory of Recreational Highway Traffic." Ontario Department of Highways, Report no. RR 128, 1967.

# *Man-Water Relationship Research and the Application of the Geographic Approach*

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The burgeoning world population, increasing by the equivalent of an additional United States every three years, is placing growing pressure on the usable land and water areas of the earth for living, working, and leisure space. Urban areas and the intensely utilized agricultural regions of the world feel the impact of most of this growth. As population increases and cities and industries expand, the need for resources increases and one of the most important of these is water. Water is a crucial requirement in maintaining the existing population concentrations and in many cases is a key factor in limiting future growth. The balance between sufficient and inadequate water supplies in many parts of the world is delicate indeed. Drought in the western United States or the series of dry years in the Sahel of Africa are examples of serious problems in providing for the water needs of an area. Many cities, like Phoenix and Los Angeles, are dependent upon water originating many miles away.

The classification, mapping, and analysis of this critical water resource is inadequate in various parts of the world. Much information is needed better to understand and use both fresh and salt water. The character of different water bodies may vary considerably, and variations can exist within the same water mass. Thus, it should be possible areally to differentiate and regionalize water areas of the earth. A fifth tradition could be added to the four identified by Pattison (1964, pp. 211-16): man-water relationships. The objective of this paper is to indicate the need for applications of geographic research to the water resource problems of the world and to demonstrate that unit area classification techniques and the regional approach are applicable to water research and analysis.

## *APPLICATION OF LAND CLASSIFICATION TECHNIQUES TO MAPPING WATER AREAS*

Land use has been one of the most persistent basic and applied research and publication themes in the discipline of geography. Attempts to find a way to map objectively what a researcher observes within the landscape have been important in the development of geography. In the early 1900s the research of many geographers was dominated by the environmental deterministic thought process, but others were seriously trying to find ways of objectively gathering field data that could be scientifically analyzed. A group of young Midwestern geographers met to discuss and develop new land use mapping techniques, first in Holland, Michigan, in 1923 and a year later in Hennepin, Illinois. A map of an area near Hennepin was developed by W. D. Jones and V. C. Finch which showed major physical and land use characteristics by a system of colors and digits (Jones and Finch 1925, pp. 148-57). This method was refined by Finch in his map of the Montfort, Wisconsin, area which first demonstrated the use of the fractional code in which digits in the numerator represented land use characteristics and digits in the denominator the physical characteristics of the land (Finch and Platt 1933, pp. 15-44). This system allowed the recording of accurate observations of the spatial character of "unit areas" in the field. The resulting data could be compared in various ways to see the degree of correlations of variables.

The fractional code or digit mapping system has been adapted for application to a variety of land use mapping problems since the Montfort study. The aerial photograph which became available in the 1930s was a major step forward in the data accumulation process. It was used as a mapping base in the Tennessee Valley rural land classification survey begun in the 1930s (Land Committee 1941, pp. 111-24). Detailed land and human use characteristics were mapped, summarized in a short fraction, and then grouped into five types in terms of the degree to which agricultural problems existed (from none to so severe that land should be withdrawn from agricultural use). Based on the summarized and interpreted fractional code information, major decisions for changes in land use and management resulted in the Tennessee Valley. Another significant application of the fractional code was in "operation bootstrap" in Puerto Rico in the late 40s and early 50s. The land inventory and resource appraisal program in Puerto Rico provided detailed information maps which became the basis for major changes in land use policy on that island.

The World War II and postwar periods saw the continued evolution of mapping systems. Quantitative methods and the computer allowed the replication of research design and methods and permitted the processing of massive data quantities in short time periods. A variety of new methods and theories were developed, and some older ones were adapted to the new technology. High-flying airplanes and earth-orbiting satellites permitted the remote sensing of the earth's surface in a manner and with a rapidity not thought possible twenty years before. Land utilization maps of the world are now possible that are similar to the British Land Utilization Survey of the 1930s. Vast amounts of data concerning the earth's surface can be collected in short time periods and used for planning and analyzing change. The U.S. Geological Survey, under the leadership of Chief Geographer James Anderson, has developed a system of classifying and mapping land use and land cover for use with remote sensor data (Anderson 1976). This system permits the gathering of land use and land cover data at various levels of detail and makes possible the mapping of thousands of square miles within a relatively short period of time.

All of these past and present land classification systems developed by geographers include water as an item but only identified as lakes, rivers, estuaries, ponds, seas, or oceans. This may indicate that the spatial characteristics of water are difficult to classify and map, that most geographers are not trained to make such observations, and that only recently have such developments as water pollution and water shortages sensitized us to the need for more attention and research on this crucial resource. Water has attributes which can be mapped and submitted to the geographic approach and analysis. Water use should be a theme of future spatial research as land use has been in the past.

## *LAND USE––INADEQUACY OF THE TERM*

The term "land use" is not adequate to cover all circumstances to which it is applied. There are many parts of the world where the earth's surface is not land as defined in Webster's dictionary–"the solid portion of the surface of the earth." About three-fourths of the earth's surface is water. In many places water areas are as intensively utilized for human activity space as the land. Examples are houseboats on the canals of Netherland or portions of San Francisco Bay; sampans in Hong Kong or Bangkok harbors; oil and natural gas exploration and production facilities in the Gulf of Mexico, Lake Maracaibo, the North Sea, off the coast of Santa Barbara, California, and the Persian Gulf; and recreational boat marinas and commercial harbors throughout the world. Many water areas are used or organized by man in ways and intensities equal to the solid surface of the earth. The marina is similar in function to the automobile parking lot; the harbor is comparable to the truck or railway marshaling yard-warehouse combination; and the petroleum field in water areas requires more labor and is more technologically complex than a similar facility found on land. Some water areas are "cultivated" or farmed as intensively as the rice paddies of China or Japan, such as the fish farms of southeast Asia.

Water areas have physical properties and human use characteristics that are more or less comparable to those of land. These can be classified, mapped, analyzed, and generalized in ways similar to studies of the solid portions of the earth. Different densities and chemical characteristics exist in water. The movement or currents differ from place to place as do the depth of water, the flora and fauna, the bottom conditions, and the resources in the solid earth underneath the water. The degree of pollution can be mapped and often correlates with man's density and waste disposal habits along water bodies as well as with the man-made items which utilize or are built on, in, or over the water.

Thus, it is proposed that water can be classified and mapped by many of the same methods as is land. The fractional code could well be successfully utilized in water use mapping. The numerator could indicate the man-caused characteristics of water such as color, pollution, types of human activity, laborer density, and so forth. The denominator could show the physical characteristics such as chemical content, depth, currents, fish and plant life, impurities, and the like. The result would be a map with as much detail of water areas as Finch produced in Montfort, Wisconsin, or Anderson by utilizing remote sensing data in Florida or Arizona. It is true that the fluidity of water may cause problems in mapping the boundaries between different categories of water types or characteristics, but such classification would be significant in planning how to conserve the water resource, improve declining quality, regulate the use, or zone for various types and intensities of use.

## *THE NORTH SEA EXAMPLE*

The North Sea has long been an important water area but until the recent petroleum developments was one of the least known parts of Western Europe (Goldberg 1973, p. 2). Freight vessels, fishing trawlers, passenger ships, and North Sea ferries for some time have made this water some of the most intensely used in the world. Now the existence of petroleum and natural gas exploration equipment such as drilling rigs, production platforms, oil and gas pipe-laying ships, tugs, and a variety of other facilities associated with the North Sea developments have been added to the normal transportation and fishing traffic. The result is the creation of water use so great that the density of human beings working as technicians on the oil- and gas-related technological facilities is greater in some places than that in the oil fields of Texas or the North Slope of Alaska.

The geology of the North Sea is such that the best oil and gas discoveries thus far are near to the line dividing the exploration rights areas of the British and the Norwegians in the northern half of the water body. Some petroleum fields extend across the British-Norwegian boundary lines. Thus far the exploration and production facilities are heavily concentrated in a narrow north-south strip in the center of the North Sea.

The Ekofisk field illustrates the degree of intensity of water space use in the North Sea (Figure 1). In this area it is possible to walk for more than 16 miles on catwalks connecting platforms for drilling, production, pipelines, booster facilities, quarters, and helicopter pads (Sommers 1976, pp. 200-14). Several hundred people are employed in this area at any given time. The quarters area, for instance, is occupied twenty-four hours a day. The same kind of intensity of development exists in other British, Dutch, and Norwegian drilling or production areas.

The actual use of water space of certain portions of the North Sea equals that of many land areas in terms of intensity and economic and political signifi-

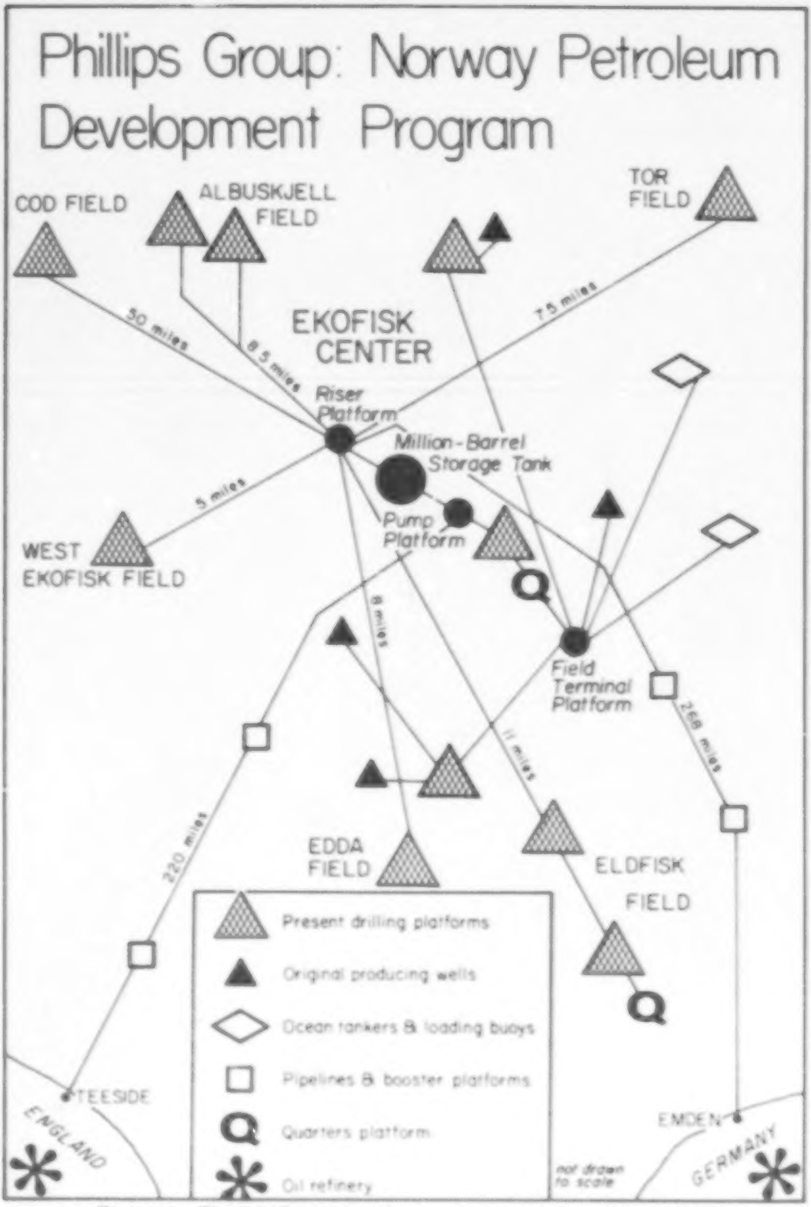
Phillips Group: Norway Petroleum Development Program
COD FIELD
ALBUSKJELL FIELD
TOR FIELD
EKOFISK CENTER
50 miles
8.5 miles
75 miles
Riser Platform
Million-Barrel Storage Tank
5 miles
Pump Platform
WEST EKOFISK FIELD
8 miles
Field Terminal Platform
268 miles
11 miles
220 miles
EDDA FIELD
ELDFISK FIELD
Present drilling platforms
Original producing wells
Ocean tankers & loading buoys
Pipelines & booster platforms
Quarters platform
Oil refinery
TEESIDE
ENGLAND
EMDEN
GERMANY
not drawn to scale

Figure 1. Ekofisk Petroleum Production Area in the North Sea

cance. Potential problems are emerging, such as increasing costs of development, difficulty of the defense of oil and natural gas installations, the potential pollution of the water and adjoining coasts, and the conflict between various users such as fishermen and oilmen. Ocean areas are a potential resource for food and minerals that scientists and politicians are now recognizing throughout the world. Georg Borgstrom has long pointed out the pivotal role of the sea in the food supply and the part that ghost acreage plays in the economy of many nations such as Japan (Borgstrom 1965, p. 160). The spatial character of the world's water areas needs to be an increasing focus of geographic research. The 200-mile economic zones along the coasts of the many countries of the world and the attempts of the Law of the Sea Conferences to find a solution to political and economic control of all ocean areas are indicators of the increasing importance of the world's salt water areas. As a fresh water supply for irrigation, industry, and domestic consumption becomes critical, the location, amounts, and quality of inland surface and ground water supplies need to become the subject of both theoretical and applied geographic research.

Water needs to become the focus of classification, areal differentiation, and spatial analysis research as has been true of land. Water is assumed in the common usage of the term "land use," but it is suggested that a new term be adopted that will include both land and water, such as "earth space use."

## EARTH SPACE USE PROBLEM MODEL APPLIED TO WATER RESEARCH

Problems related to the use of land and water areas develop as a result of either physical or human events or combinations of these two categories. The model in Figure 2 indicates the endless possibilities for cultural, physical, and regional earth space use problems and their interrelations. Problems can arise within any part of the model and in various combinations. Physical and human events and processes result in landscape and waterscape change in space and over time. Change leads to change, and this dynamic nature of the earth is of major importance to any researcher.

It is this changing character of the earth's surface that presents a challenge to the geographer attempting to understand and interpret for the layman, decision maker, and student the myriad problems that develop in using the earth's surface. These problems are micro and macro in scale and exist at all stages in between. Most of society's problems have a spatial component which is becoming more dominant as people increase the pressure of space and the resulting demands on the land, water, mineral, flora, fauna, and air resources of the world. Understanding man-land-water relationships on the earth's surface is an increasingly important variable to deal with in attempting to solve some of the grave earth space use problems.

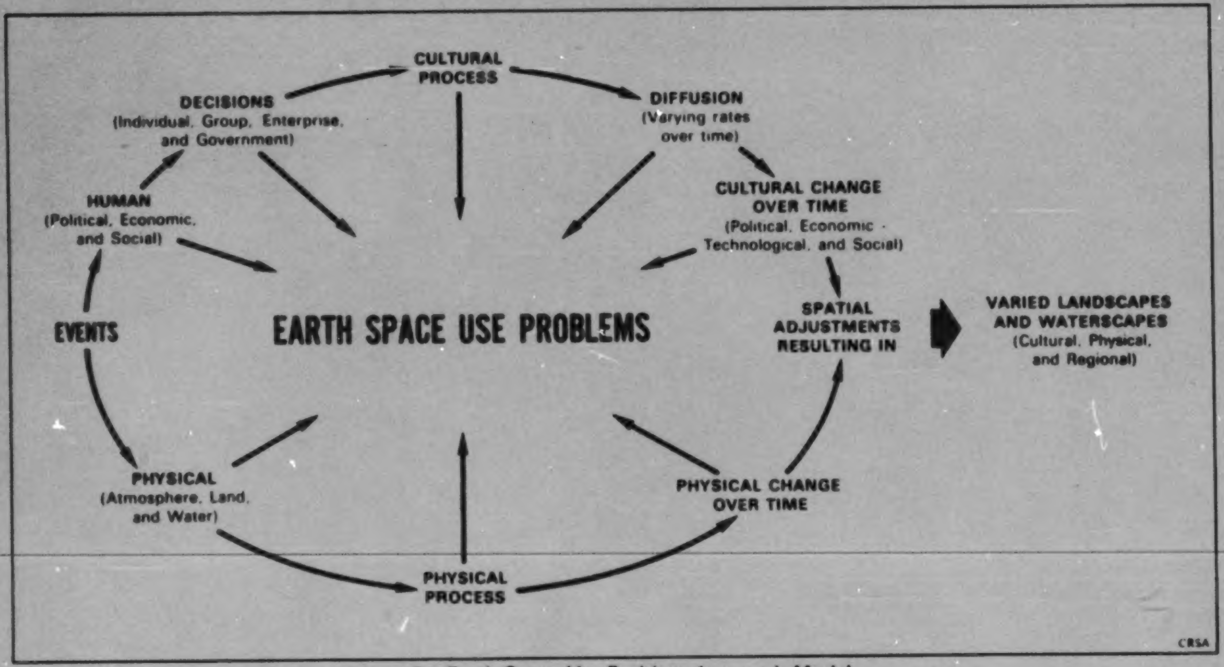
CULTURAL PROCESS
DECISIONS (Individual, Group, Enterprise, and Government)
DIFFUSION (Varying rates over time)
HUMAN (Political, Economic, and Social)
CULTURAL CHANGE OVER TIME (Political, Economic · Technological, and Social)
EVENTS
EARTH SPACE USE PROBLEMS
SPATIAL ADJUSTMENTS RESULTING IN
VARIED LANDSCAPES AND WATERSCAPES (Cultural, Physical, and Regional)
PHYSICAL (Atmosphere, Land, and Water)
PHYSICAL CHANGE OVER TIME
PHYSICAL PROCESS
CRSA

Figure 2. Earth Space Use Problem Approach Model

## CONCLUSION

The opportunity for people to improve their quality of life by discovering new land areas with accompanying resources is largely a phenomenon of the past. Resources in the world's water areas may be the last geographic frontier for humans, and man-water relationships will be of increasing future significance. The exploration of water bodies will present both opportunities and problems. The geographic approach needs to be applied to water research. Macro and micro systematic and regional geographic studies are needed of the Great Lakes, the North Sea, the Mississippi River, and the many other water bodies of the world. Water use specialists must be trained in geography to provide the data and spatial analyses of the liquid portions of the earth's surface. The past land use classification techniques, methodology, and theories need to be evaluated as to their applicability to water use research. In some places the need is urgent, and the time is now.

## REFERENCES CITED

Anderson, James, Ernest E. Hardy, John T. Roach, and Richard E. Witmer. "A Land Use and Land Cover Classification System for Use with Remote Sensor Data." Geological Survey Professional Paper 964. Washington, D.C.: USGPO, 1976.

Borgstrom, Georg. *The Hungry Planet.* New York: MacMillan, 1965.

Finch, Vernor C. and Robert S. Platt. *Geographic Surveys.* Geographic Society of Chicago, Bulletin 9. Chicago: University of Chicago Press, 1933.

Goldberg, Edward D. *North Sea Science.* Cambridge: Massachusetts Institute of Technology, 1973.

Jones, W. D. and V. C. Finch. "Detailed Field Mapping in the Study of the Economic Geography of an Agricultural Area." *Annals of the Association of American Geographers* 15 (1925) :148-57.

Pattison, William D. "The Four Traditions of Geography." *The Journal of Geography* 63 (1964) :211-16.

The Land Committee, National Resources Planning Board. "Land Classification in the Tennessee Valley Authority." In the Land Committee, National Resources Planning Board, *Land Classification in the United States,* pp. 111-24. Washington, D.C.: U.S. Government Printing Office, 1941.

Sommers, Lawrence M. "North Sea Oil: Changing Offshore and Onshore Patterns of Development." In F. E. Dohrs and L. M. Sommers, eds., *World Regional Geography: A Problem Approach,* pp. 200-14. St. Paul, Minn.: West Publishing Company, 1976.

# *In Support of Synoptic Climatology*

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Geographers have approached the study of climate from a number of points of view, and the distinctions between them are often blurred. Similar types of climatology have been defined differently by different authors, sometimes contemporaneously. We have seen static climatology, complex climatology, dynamic climatology, synoptic climatology, and physiological climatology, to name just a few (Court 1957). Each has or has had its proponents, and it may be possible to identify studies representative of each type at almost any time during the last forty years. Generally, however, the emphasis in climatological studies emerging from geography has been increasingly on explanation rather than pure description, with greater sophistication of methods and more attention given to the direct effects of climatic variability, whatever the origin, on human activity and comfort. Some of these most recent studies have focused on interface processes operating in the biosphere and the types of energy exchanges that might be relevant to organism survival; others have considered urban microclimatic processes (Bach 1972).

In spite of the new and varied emphases now emerging in climatology, two legitimate reasons remain for studying climatic distributions in terms of constituent weather patterns. First, very little has been established regarding the range of weather variations characteristic of different climates; and second, resolving climatic distributions into the component weather, however defined, has obvious pedagogical advantages (Hare 1955). Both dynamic and synoptic climatology approach the analysis and explanation of climatic patterns by way of their component atmospheric circulations. This is the viewpoint we will be emphasizing throughout our paper.

The day-to-day repetition of meteorological variables within a characteristic range of variation gives each locality its climate. On a regional scale, climatic differences arise mostly from differences in the frequency of various combinations of daily meteorological variables. For example, individual July days with identical surface temperature and dewpoint, percentage of cloud cover, and average wind speed will occur at both Sault St. Marie, Michigan, and Cincinnati, Ohio, yet both cities have different overall July climates. The difference, of course, arises from the long-term frequency of such days: most of the time, weather conditions at Cincinnati are quite different from those at Sault St. Marie. In most cases the more distant two such stations are from one another, the more dissimilar their total frequency distribution of combined meteorological parameters is likely to be; remote points on the globe might share no identical combinations. Under present atmospheric conditions, for example, no summer day in Point Barrow, Alaska, is likely to be as warm and humid as even the coolest day in Manaus, Brazil.

Regional inequalities in the usual combination of meteorological parameters that lead to climatic differentiation originate from atmospheric circulation; in other words, regional climates differ primarily to the extent that their weather patterns differ. Description and explanation of *regional* climates using this point of view--usually referred to as *synoptic* climatology--has been limited to a small number of authors. Data availability, validity, and quantity all have been a hindrance to such research. Nevertheless, geography has produced several noteworthy efforts in which climatic regions are shown to have arisen from measurable differences in circulation (Barry 1967). Meteorology has made important contributions to this understanding, too, but seldom under the heading of "synoptic climatology." Most of these works have been systematic (in the geographic sense), examining the distributions of particular details of the circulation (700 mb troughs, 850 mb lows, or moisture patterns, for example) which lead ultimately to climatic regionalization (Browne and Younkin 1970; Colucci 1976). Many of these studies were directed toward forecasting applications and have yet to be synthesized within a regional framework to show collectively the wide array of differences that distinguish present climatic regions. Researchers in Europe have contributed many synoptic studies, but we are aware of no comprehensive works that bring these findings together.

## *MAJOR CONCEPTS*

As we view it, the synoptic approach to the study of climates is underlain by several important concepts. These should comprise the central theme of any course dealing with synoptic climatology and are the assumptions from which research in this area would proceed. We shall examine them in their logical order of development.

### *The Weather Component in Regional Climate*

Regional climatic differentiation arises because of geographic differences in the frequency (and, on a broader scale, the type) of specific weather events. As noted previously, the climate of a place is the result of a frequency distribution of meteorological parameters unique to that place. Individual daily combinations of parameters may be identical to those in other places quite distant which have distinctly different overall climates, but the frequency of such combinations differs between places. A hot, humid July day with a specific combination of variables might fall in the tail of the distribution of all July days at Winnipeg, Manitoba, but near the mode of Des Moines, Iowa.

Geographic differences in the frequency distribution of such parameters for the same time period originate from differences in weather patterns (Bryson 1966). Important controls include the type and frequency of air masses, cyclones and anticyclones, and passing mid-atmospheric disturbances which may have no direct surface manifestation. Understanding the synoptic aspect of seemingly static climatic patterns enables students to visualize better the various components of a particular climate.

### *Vertical Motion and Vorticity Advection*

The linkage between surface weather and atmospheric flow is strong. The majority of surface weather features in the middle and high latitudes can be explained from the viewpoint of vorticity advection. Centers of maximum and minimum relative vorticity stimulate positive and negative divergences in the upper troposphere (>20,000′) which are linked through continuity to the surface; these centers of vorticity move generally eastward with the mid-level flow and influence a host of important weather events in which vertical atmospheric motions are important: cyclogenesis, anticyclogenesis, so-called air mass rainfall, broad areas of "frontal" precipitation, and the movement of air masses. Indeed, it is difficult to envision any important weather feature of a scale significant to regional climatic differentiation that is not in some way related to the flow aloft. Elaboration of the relationships between surface weather and upper tropospheric flow from the vorticity advection viewpoint is not difficult if one has a basic grasp of meteorological principles; a qualitative presentation of the subject is available (Harman 1971).

### *The Steering Principle*

Inasmuch as surface weather features and vorticity centers in the middle atmosphere are linked, the movement of these surface features responds to the flow aloft--the "steering principle." The short-period progression of weather across the United States, for example, is seen as an orderly and logical response to many atmospheric inputs, the most important of which is the motion of the atmosphere in the upper troposphere. At this level the preferred mode of flow is a wave pattern, with the longer waves in many cases quasi-stationary. Only centers of vorticity associated with moving short waves are normally capable of generating sufficient vertical motions to produce significant changes in surface weather, and their movement follows the general plan of the longer waves whose contours they follow. This principle enables forecasters to anticipate the trajectory of surface weather features twenty-four to forty-eight hours or longer in advance. Thus, we arrive at a point of being able to demonstrate how over a short period surface weather features may follow a repetitive pattern superimposed from the middle atmosphere. From this point it is possible to understand the orderliness of daily mid-latitude weather, in spite of first impressions to the contrary.

### *Teleconnection*

A concept corollary to the steering principle is "teleconnection"–the relationship between stationary long waves (and, hence, weather patterns) in the westerlies. It arises from the fact that the spacing of mean long waves around the Northern Hemisphere is governed by physical laws that often result in rather uniform wave lengths. As a consequence weather patterns peculiar to a particular part of the wave train may be repeated at regular intervals around the hemisphere; one such application relating 1974 weather patterns in both Europe and North America appeared recently (Harman and Matley 1976). In contrast, weather associated with different portions of a mean long wave ordinarily will be contrasting. For example, the short-term weather patterns of the eastern and western United States may differ markedly: intervals of extreme winter cold in the east usually are accompanied by unusual warmth west of the Rockies (February 1963 and January 1977 are excellent examples). Such longitudinal trade-offs are the result of the underlying tendency for the tropospheric circulation to arrange itself into quasi-stationary waves with opposite surface effects at different longitudes. The corresponding variations in mean values along a parallel of latitude greatly complicate studies of general climatic trends when the data are obtained from sample points that are not uniformly distributed around the hemisphere.

### *The Climatology of Mean Long Waves*

Circulation in the upper troposphere (and higher) organizes into climatologically probable patterns in spite of numerous day-to-day variations. Extensive findings compiled by atmospheric researchers in several fields have documented the tendency for tropospheric flow features to recur in preferred geographic areas (Stark 1965). For example, troughs at the 500 mb level persisting for thirty days or longer are highly improbable over the Front Range of the Rocky Mountains during July-August but highly probable along the New England coast; other examples, too numerous to cite here, could be described.

These climatologically probable circulations selectively deploy surface weather features over an extended period. In other words, the conservative character, through time, of this circulation and its persistent tendency to return to preferred patterns determines that specific types of weather are repetitive and hence more characteristic of some mid-latitude regions than others. Thus, the upper tropospheric flow is a principle process-set for creating general interregional climatic differentiation. It accounts for long-term patterns of air mass frequency and preferred paths for cyclonic/anticyclonic centers (both long and short term); and it helps to account for the frequency and strength of precipitation events, mean patterns of cloudiness, and variations of average surface wind speed. In short, the interpretation of mid-latitude climates from the synoptic viewpoint is both descriptive and explanatory, since location of different points with regard to important planetary (mean long) wave features not only is a way of describing a group of important climatic controls but also of explaining mean differences in surface weather patterns.

## *TRAINING AND TRAINING FACILITIES*

Ideally, training of persons who wish to study regional climatic patterns from the synoptic viewpoint would consist of several related experiences. Of course, not everyone will necessarily be able to achieve competence in every field described below, and in some cases self-training may be desirable if the local program is incomplete. We believe the expertise obtained from training listed below is necessary if synoptic climatological research is to be undertaken.

1. ***Meteorological training.*** Personnel who seek to understand the coupling between mid-level atmospheric circulation and surface weather patterns will need to have a clear grasp of basic meteorological processes. Most of these concepts are treated in introductory meteorology or physical geography courses which include such topics as the global energy balance, gas laws, energy conversions in the atmosphere (lapse rates, stability/instability, frontal or orographic lifting), and fronts and cyclones/anticyclones. Additional training in synoptic meteorology (weather map analysis) and dynamic meteorology would be useful, but adequate competence in weather map analysis can be self-taught.

2. ***Synoptic climatological training.*** The mechanisms of linkage between the surface and the mid-troposphere may be examined once familiarity with basic meteorological concepts and map analysis has been attained. Development of these relationships would be available in either a course dealing directly with them ("Synoptic Climatology") or a mid-level meteorology course that would focus on the theory of weather forecasting. If both are lacking, adequate literature on the subject is available for self-instruction.

3. ***Cognate field training.*** If synoptic climatological research is to have diversified application, the practitioner should have been exposed to interactions within other fields of the biosphere, such as soil science, botany, or forestry. Regional plant distributions lend themselves well to analysis and explanation from the synoptic viewpoint because they often have adjusted to accumulated environmental stresses, a fact which integrates them closely with day-to-day weather instead of long-term arithmetic means which often obscure important limiting

factors. Thus, training in plant or forest ecology, plant physiology, and soil science would be useful. Whatever courses or experiences are involved, the practitioner would want to be able to understand the interaction between the plants and their environment sufficiently to make intelligent decisions regarding when and to what extent climatic stresses are a factor in their distributions.

4. *Technical training.* Whatever the emphasis the synoptic climatological research would take, training in methods of analysis is important. Research design, statistics, and computer mapping are all extremely useful areas of instruction. The necessary level of training in these fields is probably now being met in most advanced graduate programs in geography within the United States and Canada.

5. *Facilities.* No better way exists for the student to become conversant with weather patterns and their mid-atmospheric linkages than to follow the evolution of daily weather. It does little good, in our opinion, to expose an individual to the training mentioned above if that person has neither the interest nor the facility to follow the sequence of weather patterns. Those which affect any point through time, though repetitive about a mode, are extremely complex; and resulting environmental stresses such as drought, if that is the research subject, might result from more than one type of circulation. Only the researcher experienced with daily weather patterns can make the intelligent decisions necessary to construct a valid research design. Such experience is not attained in a month or a year; rather, it accumulates over time as the researcher encounters the wide array of patterns possible and observes their operation. For this reason, we recommend highly that access to a weather-map facsimile receiver be a part of any synoptic climatological program. Several different weather information circuits are available. Though cumbersome, the maps received can be stored for later analysis or illustration and are a very usable product. The Daily Weather Map, Weekly Series, is inadequate because its coverage is limited and dated when received.

## *SYNOPTIC CLIMATOLOGICAL APPLICATIONS*

Research designs vary, depending in part on the problem, the overall aim of study, the available data, and the skills of the researcher. Although a hierarchy of rigor and sophistication may exist within climatological research designs appearing in geography (Terjung 1976), we prefer not to focus on this matter because often the researcher's design options are limited by either the data or his ability and also because the degree of sophistication often can be adjusted up or down by manipulation of the design if data permit. We are more concerned with the ultimate application of the research products, and we feel that a research effort has been a success if the findings have led to a better understanding of atmospheric organization and climatic differentiation or the causal relationship between weather patterns (surface and aloft) and distributions in the biosphere. For example, a rewarding outcome would be the ability to demonstrate a linkage between 500 mb flow patterns and general phytogeographical regions through a complex set of interactions. For illustration, we will examine some possible applications of synoptic climatology with the understanding that research design is variable and often externally constrained.

### *Climatic Applications - Regional*

Patterns of flow at the 500 mb level have been used to explain many climatic problems that were unanswered by more traditional approaches. For example, a precipitation peak in May and June, followed by a decline in July-August, when average temperatures and dewpoints are highest, is characteristic of a large sector in central North America, and its explanation is not obvious from surface analysis (Trewartha 1961). Mean 500 mb flow charts reveal that the relative frequency of troughs over the Rocky Mountains and western Plains is greatest during the months March through May, placing the Great Plains and Midwest in a zone of recurring positive vorticity advection which promotes a springtime maximum in the number of cyclonic passages through this area (Klein 1957). By midsummer, however, a persistent ridge normally settles in over the western Great Plains, diminishing the strength and number of passing cyclones and, hence, the total number of precipitation events over much of the central third of North America. The circulation shift from spring to summer is a hemispheric adjustment of mean long wave positions to a decreasing zonal index and the changing distribution of heat sources and sinks; continental heating, particularly, reinforces the ridge position over the western Plains.

As another example, details of the climatology of North American tornadoes and severe thunderstorms (such as their springtime maximum and the northward shift of the area of highest probability from spring to summer) are not satisfactorily explained by surface analysis. Atmospheric research has shown the importance of strong wind shear, dry air at mid-atmospheric levels, and positive vorticity advection, in addition to those factors usually required for thunderstorms, as ingredients necessary for severe storm formation. These special conditions combine much less often in summer because of mean long wave changes (see above) and the northward shift in the modal polar front jet stream position between spring and summer. Thus, the general climatology of tornadoes is intimately related to the seasonal evolution of mid-tropospheric circulation.

During the early 1970s the Great Lakes were at record or near-record high levels, and losses of shoreline property and beaches were high. These high levels followed a sustained period of low water during the 1960s, and now, since 1975, levels are falling again. These variations are related primarily to the number and efficiency of precipitation-producing disturbances moving over the Great Lakes' basin. We suspect that the number of "wet" cyclones so exceeded the long-term average during the early 1970s that it may have fallen several standard deviations above the mean, particularly during the fall of 1971. Why did several wet years follow consecutively, with such costly repercussions around the Lakes? The period was characterized by an exceptionally large number of mean five-day and thirty-day long wave troughs in the Great Plains and Rocky Mountain area, repeatedly favoring mean southwesterly flow over the Great Lakes even during seasons when such flow is normally a low-probability event. The result was an abnormally high frequency of northeastward-moving cyclones crossing the region—many of which had incorporated tropical moisture from the Gulf of Mexico that insured abundant precipitation. Total cyclonic passages may not have exceeded normal, but they did produce more precipitation because of their point of origin, a reflection of overall shifts in planetary circulation around the Northern Hemisphere.

In still another application, we know that autumn, particularly November, is a time when severe cyclonic storms have ravaged the Great Lakes, although some autumns pass without any severe storms whatsoever. Surface analysis provides few clues for these yearly variations, but analysis of hemispheric 500 mb patterns reveals that under persistent northwesterly steering flow, the likelihood of a severe cyclone on the Great Lakes is very small, though mean daily surface winds may exceed normal. Super-cyclones in the Great Lakes require both strong support aloft plus moist air input from the Gulf of Mexico or Caribbean Sea and originate in the Southern Plains or Midwest, traveling northeastward with associated southwesterly flow. Autums characterized by mean 500 mb ridges over the western half of North America and northwesterly flow therefore carry a low probability of such storms because under such regimes southwesterly flow is uncommon; those with westerly or southwesterly mean flow and a mean trough over the West pose a much higher threat.

Synoptic processes are strongly related to plant distributions. In spite of high (>45") average annual precipitation, much of the interior southern United States, such as the Piedmont and the Ozark Plateau, supports a forest distribution which suggests that availability of soil water is an important limiting factor. Only in the moister regions of the Appalachians are mesic species widespread; elsewhere in this region drought-tolerant oaks, hickories, and pines are prevalent. At first glance, these conditions are unexpected because annual precipitation is high and summer dewpoint values average in the 65°-75°F range, indicating abundant low-level precipitable moisture. However, much of this area receives only occasional summer rains. Although these may be heavy and make up a large percentage of total seasonal receipts, they are separated by periods many days in length of no rain, so moisture deficits accumulate during the summer. Why, in spite of the heat and moisture available for convective activity, is precipitation relatively low and the resulting natural vegetation a matrix of drought-tolerant species? The missing ingredient is a lifting mechanism. During most summers frontal penetration of this region is infrequent, the air aloft is warm (increasing stability and leading to isolated or scattered precipitation when it occurs, since only a few convective towers can penetrate the inversion), and most of the short waves in the middle atmosphere are steered eastward, rather than southward, across the Midwest, Great Lakes, and mid-Atlantic states and New England.

Those that do extend into the South support weak vorticity gradients because upper-level wind speeds are low. As a result, with random convection unable to provide general rainfall coverage and other disturbances passing infrequently, available soil moisture declines through the summer, and some drought tolerance is necessary for most upland tree species to survive.

## *ATMOSPHERIC CIRCULATION AND PHYTOGEOGRAPHY IN THE MIDWEST: AN EXAMPLE OF RESEARCH DESIGN*

Biotic communities competitively adjust to the summation of environmental stresses created by atmospheric conditions. Traditionally climatologists and biogeographers have attempted to explain the location of vegetation transitions (ecotones) using static meteorological parameters. Physiological research does not yet allow us to specify the critical environmental element(s) responsible for every ecotone, and the degree of causation between climate and vegetation patterns is still imperfectly understood. We suggest, nevertheless, that climatologists could carry their explanatory research in this area at least one step further, namely, an examination of the synoptic patterns responsible for climatic stresses that generate or reinforce ecotones. Underlying this proposal, of course, is the assumption that most regional ecotones are climatically set and that eventually our knowledge of physiological ecology will expand to the point of permitting us to identify specific causative relationships. Certainly the general agreement between weather patterns and plant distributions implies causation, and several recent research efforts have supported this implication. For example, a coincidence of ecotones and air-mass-defined climatic boundaries has been shown for the margins of both the corn belt and boreal forest in North America (Bryson 1966), the tundra-taiga boundary in Eurasia (Krebs and Barry 1970), and the southern boundary of the extension of Pacific flora (the "Pacific Peninsula" or "Inland Empire") into the northwestern United States (Mitchell 1976). The following research design is presented as an example of how analysis of the relationship between daily weather and middle atmospheric flow (synoptic climatology) can help explain several phytogeographical patterns in North America.

The specific research problem deals with the relationship between the environmental factors that determine vegetation distributions in the upper Midwest and the patterns of upper tropospheric circulation. Within this area a series of vegetation transitions exists northeastward from tall-grass prairie in eastern Nebraska and northwestern Iowa through oak-hickory and beech-maple or maple-basswood deciduous forests to the mixed coniferous and deciduous Great Lakes Hardwood Forest across Upper Michigan, northern Wisconsin, and northeastern Minnesota (Figure 1). Analysis of the mean 500 mb height contours (for the growing season) shows that the upper Midwest is also an area of transition from anticyclonic curvature associated with a mean ridge over the western Great Plains to the cyclonic curvature associated with a mean trough in the eastern United States (Figure 2). We hypothesize that the most frequent (modal) patterns of

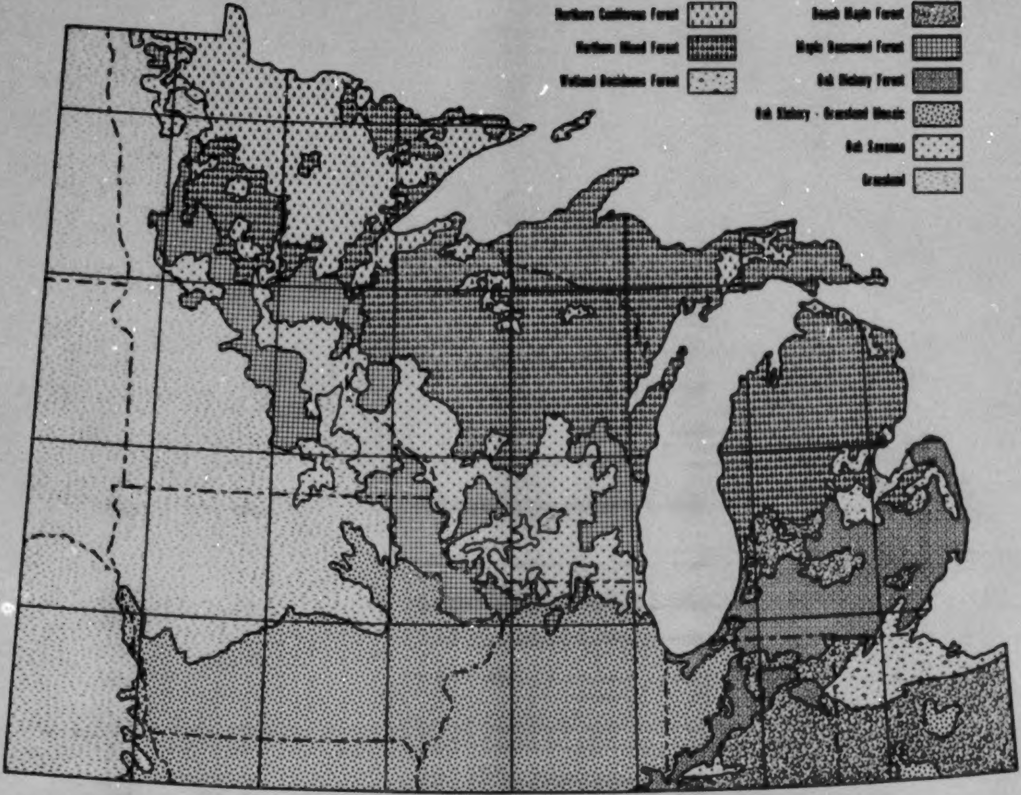
Northern Coniferous Forest
Northern Mixed Forest
Wetland Deciduous Forest
Beech Maple Forest
Maple Basswood Forest
Oak Hickory Forest
Oak Hickory - Grassland Mosaic
Oak Savanna
Grassland

Figure 1. Generalized Vegetation Patterns of the Upper Midwest

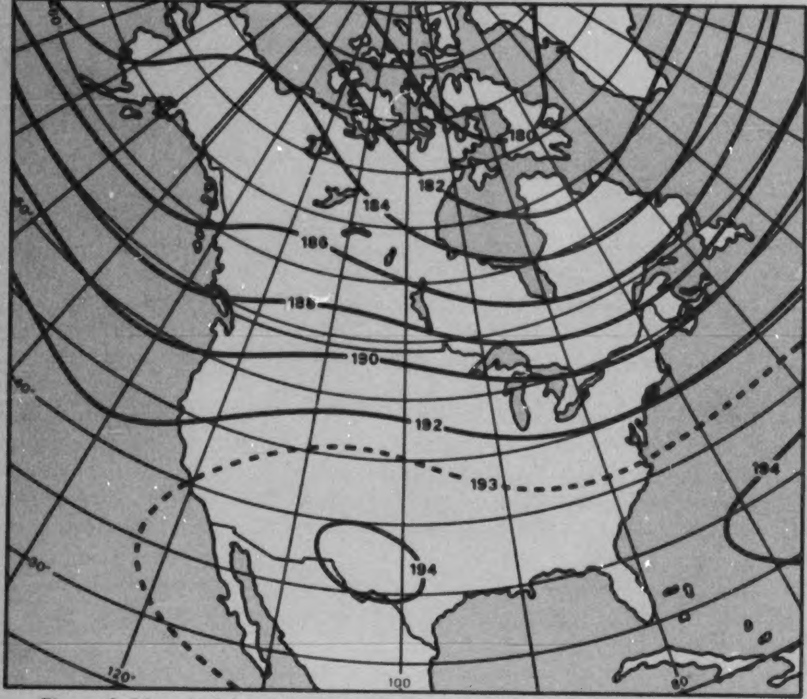

Figure 2. Mean Height of the 500 mb Surface for July (in hundreds of feet); after Lahey et al. (1958).

middle atmospheric circulation are the controlling factors in determining the surface environmental gradients that control the position of the ecotones.

One research design that may be used to test this hypothesis has three major divisions, and we will deal with each separately. First, the environmental factor(s) important in controlling the distribution of dominant vegetation in the study area should be determined. The environment operates to determine the distribution of woody species by affecting the rates of reproduction and seedling mortality. Physiological damage that results in injury or death to seedlings and therefore limits tree distribution is the result of prolonged physiological stress. For example, studies of the growth of tree vegetation in the mixed prairie of the central United States have concluded that "reproduction from stumps or seedlings only rarely occurs" because injury and death were primarily the result of "continuous adverse conditions over an extended period of time" (Albertson and Weaver 1945). These physiological stresses are the result of the inability of the plant to obtain sufficient moisture to carry on the necessary processes of photosynthesis and respiration. Water stress causes both stomatal closure, limiting $CO_2$ uptake, and biochemical stresses induced by decreased water potential in the leaves (Federer and Gee 1976). Moisture stress in the plant is directly related to decreased soil moisture content. The longer that moisture has been deficient in the soil, the greater the effects of moisture stress on plant activity. Hence, general patterns of moisture availability are the primary environmental factor determining the distribution of tree vegetation (Zimmerman and Brown 1971).

The second major section of the research design is concerned with the relationships between surface weather patterns and the amount of moisture available for plant development. The water balance (Thornthwaite 1948) is one method of calculating the amount of soil moisture available for plant growth. The two major components of the water balance that affect soil moisture depletion are precipitation receipts and evapotranspirative losses, both regulated by day-to-day changes in the patterns of surface weather. The daily potential evapotranspirative flux can be estimated using the Penman method (Penman 1963) from atmospheric data recorded at first-order National Weather Service stations. The Penman method combines both energy budget and aerodynamic methods of calculating potential evapotranspiration. Data to estimate potential evapotranspirative flux consist of (1) temperature measurements (daily maximum and minimum), (2) a measure of solar radiation (percent possible sunshine or degree of cloud cover), (3) the daily mean dew point temperature, and (4) the daily wind run. A combination of the daily evapotranspirative flux with the daily precipitation receipts would yield a measure of daily atmospheric-induced moisture stress.

In order to determine which weather patterns contribute most to the environmental gradients responsible for present vegetation distributions in the upper Midwest, data from a matrix of weather stations within the study area could be analyzed. Daily values of moisture stress can be calculated for all stations in the matrix, with categories of moisture stress developed according to the orientation of the daily stress gradients across the study area. Each category could be analyzed to determine which general patterns of surface weather are responsible. Those categories having an alignment suggesting a causal relationship with the ecotones should then be identified, with individual days belonging to these categories being examined in detail to determine the types of 500 mb circulations with which they are associated. The frequency of these circulations compared to all circulations that affect the study area can be calculated to determine if they are modal. If the hypothesis is to be accepted, the results should show that modal flow patterns in the middle troposphere are associated with distributions of moisture stresses at the surface that conform to the plan of the ecotone, suggesting that Midwestern phytogeographic boundaries have adjusted not to rare, extreme events but to the long-term patterns of accumulated stress.

Possible results from this research design include the following: (1) a statement regarding the usefulness of the research design in demonstrating the linkage between surface weather patterns and the upper tropospheric circulation in the

Midwest and the feasibility of its application to other areas; (2) a statement concerning the relationship between modal upper tropospheric flow and the surface stresses that reinforce ecotones. Alternatively, a new hypothesis may be developed relating extreme surface conditions that might help control ecotone position with the associated flow patterns; (3) the ability to infer tropospheric circulations for periods predating the availability of upper atmospheric data by using the linkage established here between surface weather and circulation patterns if surface weather data are available or can be inferred from other sources.

## *CONCLUSION*

What do we know about regional flow patterns under extreme daily weather conditions? What do we know about the conditions leading to drought in the Midwest, excessive wetness along the eastern seaboard, or damaging growing-season freezes in the Canadian prairie or the fruit belts of the Great Lakes? How do we account for the rare but damaging freezes in the Texas or California fruit areas? And what about road-blocking snowfalls in the Great Lakes' snowbelt areas: can their likelihood be estimated from preexisting (autumn) circulation patterns? Clearly, such disruptive extremes are likely to occur only when specific types of atmospheric circulation are established. Do we know what these circulations are, and do they have any antecedent patterns to foreshadow them? How are the associated circulations identified, and where does the specific pattern begin to evolve when atmospheric oscillation, fluctuation, and reorganization (albeit about preferred patterns) are continuous? By identifying days of extreme conditions, combining them as one population, and analyzing the associated 500 mb flow, one might be able to detect many similarities, particularly as the daily flows are unfolded back through time for each event, in order to examine pattern development. Is it probable that some weather extremes are more highly associated with certain mean long wave patterns than with others? As we reported earlier regarding the incidence of severe autumn storminess on the Great Lakes, the answer is clearly affirmative. But, first, much work needs to be done to improve our understanding of the *degree* of linkage between surface weather and higher-level circulation. Extremes of weather could be identified with companion daily circulations, and the likelihood of these circulations developing might then be determined for most of the different mean long wave patterns that typically occur at that season. Unfortunately, we have an imperfect understanding of the modal 500 mb circulations that now develop seasonally over North America. Mean flows have been determined, but these, regrettably, mask daily alterations.

These questions fall in the realm of synoptic climatology. We submit that the synoptics of weather extremes in central/eastern North America will become of even greater concern in the future as interest in food production increases. Who will be providing these important answers? Heretofore, most have come from meteorology, primarily, we think, because few geographers were equipped with the necessary understanding of basic atmospheric physics to contribute. With the increasing availability of atmospheric science programs in higher education, as well as the expanding availability of qualitative treatments of the subject, we hope that more geographers will help. The job is waiting to be done; and as the old adage goes, if we don't do it, somebody else will.

## *REFERENCES CITED*

Albertson, F. W. and J. E. Weaver. "Injury and Death or Recovery of Trees in Prairie Climate." *Ecological Monographs* 15 (1945) :395-433.

Bach, Wilfrid. "Computerized Evaluation and Representation of Air Quality Data." *Proceedings, Association of American Geographers* 4 (1972) :1-9.

Barry, R. G. "The Prospect for Synoptic Climatology: A Case Study." In Robert W. Steel and Richard Lawton, eds., *Liverpool Essays in Geography*, pp. 85-106. London: Longmans, 1967.

Browne, R. F. and R. Younkin. "Some Relationships Between 850-mb Lows and Heavy Snow Occurrences over the Central and Eastern United States." *Monthly Weather Review* 98 (May 1970) :399-401.

Bryson, Reid A. "Air Masses, Streamlines, and the Boreal Forest." *Geographical Bulletin* 8 (1966) :228-69.

Colucci, Stephen J. "Winter Cyclone Frequencies over the Eastern United States and Adjacent Western Atlantic, 1964-1973." *Bulletin, American Meteorological Society* 57 (May 1976) :548-54.

Court, Arnold. "Climatology: Complex, Dynamic, and Synoptic." *Annals, Association of American Geographers* 47 (June 1957) :125-36.

Federer, C. A. and G. W. Gee. "Diffusion Resistance and and Xylem Potential in Stressed and Unstressed Northern Hardwood Trees." *Ecology* 57 (Late Summer 1976) :975-84.

Hare, F. Kenneth. "Dynamic and Synoptic Climatology." *Annals, Association of American Geographers* 45 (June 1955) :152-62.

Harman, Jay R. *Tropospheric Waves, Jet Streams, and United States Weather Patterns.* Commission on College Geography Resource Paper no. 11, 1971.

Harman, Jay R. and Ian M. Matley. "Weather Note: the Growing Season of 1974." *The Professional Geographer* 28 (February 1976) :45-49.

Klein, William H. *Principal Tracks and Mean Frequencies of Cyclone and Anticyclones in the Northern Hemisphere.* United States Weather Bureau Research Paper no. 40, 1957.

Krebs, J. S. and R. G. Barry. "The Arctic Front and the Tundra-Taiga Boundary in Eurasia." *The Geographical Review* 60 (1970) :548-54.

Lahey, James F. et al. *Atlas of 500 mb Wind Characteristics for the Northern Hemisphere.* Madison: University of Wisconsin Press, 1958.

Mitchell, Val L. "The Regionalization of Climate in the Western United States." *Journal of Applied Meteorology* 15 (September 1976) :920-27.

Penman, H. L. *Vegetation and Soils.* Commonwealth Bureau of Soils Technical Communication no. 53, 1963.

Stark, L. P. "Positions of Mean Monthly Troughs and Ridges in the Northern Hemisphere." *Monthly Weather Review* 93 (1965) :705-20.

Terjung, Werner H. "Climatology for Geographers." *Annals, Association of American Geographers* 66 (June 1976) :199-222.

Thornthwaite, C. W. "An Approach Toward a Rational Classification of Climate." *Geographical Review* 38 (1948) :55-94.

Trewartha, Glenn T. *The Earth's Problem Climates*, pp. 280-83. Madison: The University of Wisconsin Press, 1961.

Zimmerman, Martin H. and Claud L. Brown. *Trees: Structure and Function*, p. 162. New York: Springer-Verlag, 1971.

# *Some Applications of Geomorphic Research to Societal Needs*

**HAROLD A. WINTERS**

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The nature of geomorphic research varies considerably because the subject is studied from a number of viewpoints (Falcon 1971; Zakrzewska 1971; Dury 1972; Butzer 1973). This is apparent from the different definitions (American Geological Institute 1960; Stamp 1966) and branches (Fairbridge 1968, pp. 403-24) of the discipline. The field's continuing development, coupled with a growing interest in the quality of the environment, has made certain aspects of the subject increasingly relevant to society (Coates 1971, pp. 1-6). The purpose of this paper is to show how three quite different investigations may relate to opportunities, problems, and needs of society. The first involves the discovery of a natural resource, the second is concerned with the problem of shoreline erosion, and the third presents an example of how geomorphic features of special significance may be identified and preserved for society.[1]

## *DISCOVERY OF A NATURAL RESOURCE*

The subhumid climate is a major characteristic of the glaciated Great Plains located within the United States. At many places the availability of water is of concern because the annual consumption per capita is increasing but the supply is limited. The amount of surface water available can be calculated fairly accurately, and the supply enhanced by storage involving dams and reservoirs. However, many places do not have access to this source; and, as a result, water in the ground is utilized. The most accessible aquifers are located at or near the surface and are often known on the basis of landforms and associated sediments by the geomorphologist as well as empirical knowledge of the well driller and lay person. As a result, most of these aquifers have been identified and are being utilized to varying degrees. But many places in the northern Great Plains are not near either of these types of aquifers or suitable sources of surface water. Bedrock formations deep in subsurface may also yield large amounts of water but much is of unsuitable quality.

Another source of water that may be adequate in terms of quantity and quality exists within the glacial drift overlying bedrock but beneath the surface aquifers and streams. Many of these buried aquifers consist of porous glaciofluvial sediments that are thick, extensive, and capable of recharge by ground water. The problem is how to find this natural resource so that it may be utilized.

Prior to Pleistocene glaciation much of the drainage of the northern Great Plains was east and north (Flint 1955, plate 7; Bluemle 1967; Kelly and Buturla 1967; Laird 1967). Numerous streams eroded valleys that were roughly proportional to their size into the bedrock surface. The formation of Pleistocene continental glaciers blocked the northeast-flowing rivers and diverted drainage to the lowest available routes, which tended to be toward the southeast. Glacial advances and marginal retreats resulted in the formation of numerous cross-cutting valleys (Laird 1967). The resulting drainage network is complex because glaciation took place several times. It is apparent that some of these valleys served as major meltwater channels because many contain large amounts of glaciofluvial sediments. The valleys (and the sediment they contain) are not apparent in the present topography because they have been completely filled and buried deeply by glacial drift from multiple glaciations that affected the area. Some of the largest glaciofluvial deposits buried in the subsurface are associated with the valleys (either preglacial or diversionary) that were eroded in the bedrock surface and may be especially important aquifers because of their sedimentary characteristics, linear extent, stratigraphic position, and resulting recharge potential.

Applied research may determine the location of buried aquifers. Investigations in Stutsman County, covering an area of more than 2,300 square miles in south-central North Dakota, may serve as an example (Winters 1963; Huxel and Petri 1963, 1965). Water suitable in quality is limited in the area, and surface drainage is not presently desirable for human use. Only two major aquifers are known to exist at or near the surface: one associated with the alluvial sediments of a river valley that extends south through the east-central part of the county and another related to an extensive glacial outwash plain located in the remote and sparsely settled area far to the northwest. Water from bedrock beneath the glacial drift is of poor quality. Apparently if any additional sources for ground water exist, they will most likely be associated with buried aquifers, which, in turn, may be related to the nature of the bedrock surface.

Research involved three main components: (1) study of the surface formations, (2) investigation of existing water wells, and (3) implementation of a scientific drilling program. The first involved the detailed mapping of landforms, sediments, and bedrock exposures. This information provided a better understanding of the bedrock surface and characteristics of the overlying drift. The second consisted of an inventory of every known water well in the county. Owners were questioned about the depth and development of their wells, and measurements were taken as a measure of reliability. About 2,400 wells were inventoried, and 800 of these provided some useful information on the buried drift or bedrock surface. The drilling program provided the most detailed and meaningful data on subsurface conditions. About 200 test holes, with samples collected at five-foot intervals, were drilled; and 165 of these penetrated bedrock. As the drilling progressed, these data were continually reevaluated, and subsequent test holes were located at places where the existence of bedrock valleys was judged most likely.

Information from all three components provided a basis for the construction of a map that shows the configuration of the bedrock surface underlying the glacial drift. This map reveals the partial extent of an unusually large and deep bedrock valley in the eastern part of the county that is not expressed in the existing topography. Logs of test holes drilled within the boundaries of the valley show the presence of thick and extensive deposits of glaciofluvial sediments. Groundwater pumping tests indicate that the resulting aquifer is larger and of greater potential than any other in the county.

## *THE PROBLEM OF SHORELINE EROSION*

Lake Michigan, like the other Great Lakes, experiences changes in average water level from year to year. Much of the coast is characterized by bluffs composed of unconsolidated Quaternary sediments. During and after periods of high water levels, especially in conjunction with spring and fall storms, erosion may be severe along some parts of the shoreline. Many residences are situated along the coast, and landowners tend to place a high personal and commercial value on their property. At times of rapid bluff erosion their concern may become especially intense, and some are severely frustrated by their inability to manage the situation satisfactorily. Many do not realize that they are dealing with an ongoing natural climatic and geomorphic system that involves an immense amount of potential energy operating within the framework of geologic, not human, time. A better understanding of this condition may result in a considered and wiser use of those coastal areas that are susceptible to significant amounts of erosion. The application of geomorphic research may determine which areas are experiencing the most rapid erosion, provide quantitative data on amounts of bluff recession, and present reasonable estimates of bluff positions in the future.

Any meaningful assessment of bluff recession rates requires quantitative data from a number of sites over a period of years. Long-term comprehensive studies concerned with bluff retreat are generally lacking. Aerial photographs and most maps are of limited use because they are either too recent or they lack the amount of detail that permits precise measurement. One source of information, the record books of the United States Land Office Survey, may provide useful information on the former position of the shoreline or bluff crests.

The areas adjacent to Lake Michigan were surveyed for the most part in the 1830s, and this information is available at the respective state offices. As a result, it may be possible to determine the magnitude of bluff recession by resurveying the same lines that were measured more than 100 years ago and comparing the data. A number of individuals have done this for bluffs along the coast of Lake Michigan (for example, see Andrews 1870; Chamberlin 1877; Ball and Powers 1930), but the most comprehensive study was completed by Powers in 1958. He resurveyed a number of lines and reported on both the total amount of bluff retreat and the yearly average recession rates. Buckler (1973) and Buckler and Winters (1975) studied several sites along the southeast shore of the lake that had been previously resurveyed by Powers (1958). They compared erosion rates between the 1830s and 1956-57 with recession from 1956-57 to 1973. On the basis of these studies, it is reasonable to conclude that (1) if erosion takes place, it tends to be periodic rather than continuous; (2) the recession rates of bluff crests may vary both spatially and chronologically; and (3) in areas of rapid erosion, the annual rate of bluff crest retreat may average 1 to 3 feet per year, and in some places may exceed that figure. Obviously hundreds of feet of bluff recession have taken place along parts of the Lake Michigan shoreline in the last 130 years.

This type of research may be applied in two ways. First, it demonstrates that bluff recession is an active geomorphic process resulting in significant and measurable change at some places. Apparently in some places only the most extraordinary and expensive means are successful in controlling the erosion of bluffs that historically have been undergoing retreat, and these efforts may actually increase recession rates at other nearby locations. Apparently geomorphic processes along a shoreline tend to exist within a dynamic teleconnected system. That is, on both a small and large scale, changes in shoreline conditions at one place result in some sort of adjustments at another. Obviously shoreline recession is normal at some places, and the public should be aware of this in their use of land along such coasts.

Second, on the basis of uniformitarianism, it is reasonable to conclude that processes active along the shoreline in the past and present will function in a similar manner in the future. If this reasoning is correct, estimates may be made regarding future positions of bluff crest with the assumption that the natural ongoing processes are not significantly modified by humans. The predicted position of bluff crests may then be plotted on large-scale maps and aerial photographs. As a result, the potential future impact (barring modification of shoreline conditions) can be assessed geographically and economically and should prove useful to both the private and public sectors of society.

## THE IDENTIFICATION AND PRESERVATION OF GEOMORPHIC SITES

Recently there has been a tendency toward increased concern for the preservation and protection of scenic and wilderness areas. Such areas may be of special interest to geomorphologists (and other physical geographers) because of their physiographic component. Many parks have been established, at least in part, on the basis of unique or especially significant geomorphic conditions; but these are of limited extent, and many are not easily accessible to the public. Many other places exist that are also significant in these terms, but they have not been given status that would insure their preservation for the future. Applied research can aid in the identification and understanding of existing features and areas, including those in proximity to concentrations of populations, that may be increasingly significant to society in the future.

On August 3, 1972, the governor of the state of Michigan approved Act number 241 involving House Bill number 4881 known as the "wilderness and natural areas act of 1972." The act established a Wilderness and Natural Areas Board that "shall make recommendations for the dedication and administration of wilderness areas, wild areas, and natural areas in accordance with this act." In carrying out its responsibility, the Board sought input of information from various sources. One of the many subjects that interested them was the geomorphology of the state with special reference to established or potential wilderness and natural areas. In 1973 the Board authorized the formation of a "Landforms and Geology" committee that was, among other things, to identify specific sites of special interest within the state. The first major activity of the committee, consisting of two geologists, an earth science teacher, and a geographer, was to conduct a statewide survey to identify potential wilderness or natural areas that might be suggested to the Board for purposes of preservation.[2] Practically every professional geographer, geologist, and earth science or geography teacher in the state was invited, in one way or another, to recommend areas that were, in their opinion, of special significance and deserving of preservation. The response was considerable; and, on this basis and the expertise of the committee, fifteen sites were identified and submitted to the Board for their consideration. In addition, a "landform" or "geologic" marker was designed and erected on a local esker in cooperation with the Parks and Recreation Division, City of Lansing, Michigan. It is intended to serve as a model for educational signs that may be constructed within wilderness and natural areas in the future. Presently the committee is entering a new phase of activity that involves the preparation of reports on the geomorphology of each of the established wilderness and natural areas that exist within the state. Such information should prove useful to both the Board and the interested public. Thus, applied research of this nature can provide a better understanding of the existing landscape as well as enrich the potential experience of citizens tomorrow.

## *CONCLUSIONS*

Three quite different examples of applied geomorphic research have been described, but they are neither unique nor comprehensive. Studies involving the discovery, supply, and utilization of water in the ground are too numerous to begin to list here. Geomorphology's role in recognition of many other natural resources has been considerable. Problems relating to geomorphic processes, shoreline and otherwise, have traditionally been a topic of study by many geomorphologists, and apparently their concern in this area is increasing. The preservation and accessibility of especially significant geomorphic sites is probably of greater interest to geomorphologists than ever before, and in some places the accomplishments have been considerable.[3] But it is important to recognize that many other types of geomorphic study have also provided concepts and data that are relevant to human needs. Examples include modern soil erosion and sedimentation rates, mass wasting processes, watershed planning, humans as geomorphic agents, aesthetics of the environment, natural hazards, and fluvial systems, to name just a few. Collectively the many different types of applied geomorphic research clearly have the potential to serve society's needs more effectively in the future than they have in the past.

## *NOTES*

1. Professional geographers were involved in each of the three activities described in this paper.
2. Members of the committee: Ms. Jane Bricker (Mason, Michigan, Public Schools), Professor Donald Eschman (University of Michigan), Mr. Irvin Kuehner (Michigan Geological Survey), and Professor Harold Winters (Michigan State University).
3. A good example is the establishment of the Ice Age Scientific Natural Reserve in Wisconsin.

## *REFERENCES CITED*

American Geological Institute. *Glossary of Geology and Related Sciences.* 2nd ed. Washington, D.C.: American Geological Institute, 1960.

Andrews, Edmund. "The North American Lakes Considered as Chronometers of Post-Glacial Time." *Transactions of the Chicago Academy of Science* 2 (1870) :1-24.

Ball, J. R. and W. E. Powers. "Shore Recession in Southeastern Wisconsin." *Transactions of the Illinois Academy of Science* 22 (1930) :438.

Bluemle, John P. "Preglacial Topography and Drainage in Part of Northeast North Dakota." In Lee Clayton and Theodore F. Freers, eds., *Glacial Geology of the Missouri Coteau and Adjacent Areas,* pp. 131-32. Miscellaneous Series 30. Grand Forks: North Dakota Geological Survey, 1967.

Buckler, William R. "Bluff Erosion at Selected Sites Along the Southeastern Shore of Lake Michigan." Unpublished research paper, Michigan State University, Department of Geography, 1973.

Buckler, William R. and Harold A. Winters. "Rates of Bluff Recession at Selected Sites Along the Southeastern Shore of Lake Michigan." *Michigan Academician* 8 (1975) :179-86.

Butzer, Karl W. "Pluralism in Geomorphology." *Proceedings of the American Association of Geographers* 5 (1973) :39-43.

Chamberlin, T. C. *Geology of Wisconsin,* vol. 2, pp. 219-33. Madison: Wisconsin Commissioner of Public Printing, 1877.

Coates, Donald R., ed. *Environmental Geomorphology.* Binghamton: State University of New York, 1971.

Dury, George Harry. "Some Recent Views on the Nature, Location, Needs and Potential of Geomorphology." *The Professional Geographer* 24 (1972) :199-202.

Fairbridge, Rhodes W., ed. *The Encyclopedia of Geomorphology.* New York: Reinhold, 1968.

Falcon, H. L. "The Geological Background to Geomorphology." *Geographical Journal* 137 (1971):395-98.

Flint, Richard Foster. *Pleistocene Geology of Eastern South Dakota.* Geological Survey Professional Paper 262. Washington, D.C.: U.S. Government Printing Office, 1955.

Huxel, C. J., Jr., and L. R. Petri. *Geology and Ground Water Resources of Stutsman County, North Dakota. Part 2, Ground Water Basic Data.* Survey Bulletin 41. Grand Forks: North Dakota Geological Survey, 1963.

———. *Geology and Ground Water Resources of Stutsman County, North Dakota. Part 3, Ground Water and Its Chemical Quality.* Bulletin 41. Grand Forks: North Dakota Geological Survey, 1965.

Kelly, T. E. and Frank Buturla, Jr. "Pleistocene Diversion of Streams in Central North Dakota." In Lee Clayton and Theodore F. Freers, eds., *Glacial Geology of the Missouri Coteau and Adjacent Areas,* pp. 117-21. Miscellaneous Series 30. Grand Forks: North Dakota Geological Survey, 1967.

Laird, Wilson M. "A Note on Preglacial Drainage in the Northern Great Plains." In Lee Clayton and Theodore F. Freers, eds., *Glacial Geology of the Missouri Coteau and Adjacent Areas,* pp. 167-70. Miscellaneous Series 30. Grand Forks: North Dakota Geological Survey, 1967.

Powers, William E. "Final Report: Geomorphology of the Lake Michigan Shoreline." Unpublished report on a contract between the Office of Naval Research, Navy Department, and Northwestern University, Project NR 387-015, Contract Nonr-1228 (07). Evanston, Ill.: Department of Geography, Northwestern University, March 1958.

Stamp, Sir Dudley. *A Glossary of Geographical Terms.* 2nd ed. New York: Wiley and Sons, 1966.

Winters, Harold A. *Geology and Ground Water Resources of Stutsman County, North Dakota. Part 1, Geology.* Bulletin 41. Grand Forks: North Dakota Geological Survey, 1963.

Zakrzewska, B. "Nature of Landform Geography." *The Professional Geographer* 23 (1971) : 351-54.

# *Geographers and Asia's Development Problems*

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Surely one of the most profound changes of the post-World War II era has been the decline of colonialism and the emergence of a multitude of newly independent states, most of them extremely poor, in need of and anxious for an improvement in the quality of life for their citizens. These "new" states, many of which actually contain some of the oldest cultures in the world, have found the path of national development quite difficult. The so-called "developed" nations, which are simply those further along the continuum rather than at some imaginary end point in the development process, have not been spared painful problems either, as the period of the early 1970s has demonstrated.

Perhaps more than any other major world region, Asia embodies the entire spectrum of problems that the countries of the world face today in their efforts to modernize their societies. Here would seem to be fertile ground for scholars concerned with development issues to spend their lifetimes in productive research. Unfortunately, and curiously, this has not been the case, at least not with geographers. Both Asia as a region of specialized study and the broad theme of development have not been primary concerns of professional geographers in the Western world, particularly the United States, with probably more geographers than all the other Western countries combined. The trends in American geography during the post-World War II era are well known and hardly need repeating. It is worth noting, however, that the trend has been largely toward quantitative and theoretical geography, often without any regional focus at all. What regional interest remains seems mostly oriented toward North America. Those geographers still concerned with regional studies have bemoaned this trend (Mikesell 1973), but to little avail, it seems.

The purpose of this paper is to review this state of affairs; to indicate the value and importance of Asia as a regional focus of study by geographers (as if such indication were even necessary), particularly in the realm of development issues; to note some of the past involvement of geographers in this area; and finally to identify some of the major research opportunities in development issues that await the geographer. It is my contention that American geography in particular has been provincial in its regional focus for a nation with such vital national interests in Asia.

## *THE IMPORTANCE OF ASIA TO THE WORLD AND TO GEOGRAPHERS*

To an Asianist in any discipline, it seems almost superfluous to need to explain or justify the importance of the area. Probably all regional specialists are inevitably biased toward their region. Nevertheless, Asia's significance to the world, to geographers, and to those concerned with development issues seems particularly compelling.

Consider the population of the continent. More than half of the world's people live in the twenty-five states of Asia that stretch from Japan in the east to Pakistan/Afghanistan in the west.[1] Two of those states (China, India) alone account for more than one-third of the world total. Historically, Asia is the birthplace of some of the world's oldest cultures which have enriched mankind beyond measure. Politically, Asia comprises the many forms of national organization, from doctrinaire communist states to Western-type democracies to anachronistic remnants of the colonial era. From the viewpoint of territorial size and resource base, Asia contains political units that vary from micro-city states dependent on the outside world for virtually every commodity needed for sustenance and growth, to some of the world's largest and most self-sufficient nations. Economically, the states of Asia vary in nearly all levels of development, from some of the richest countries in the world to some of the most impoverished. Within these diverse states, a multitude of development models have been followed in the postwar era, ranging from highly centralized economies to laissez-faire capitalism. In short, it would be difficult to identify a major development problem that does not exist in Asia. In this vast, important, and profoundly interesting region is the world itself, in all its glory and all its tangled problems. Here indeed is a region worthy of the attention of geographers.

## *WESTERN GEOGRAPHERS AND ASIA*

From my viewpoint, however, the response of Western, particularly American, geographers to Asia and its development problems does not seem adequate either in quantity or quality. To be sure, the number of geographers oriented toward Asia has increased greatly in the past twenty-five years. Around 1950 there were probably no more than one or two dozen that professed such interest. Today there are at least 300 members of the Association of American Geographers (AAG) who claim Asia or some subregion thereof as their regional specialty. However, it is a fact that only a small percentage of these are actively engaged in the study of Asia in terms of research and writing, and even a smaller proportion are concerned with development issues.[2] Although a comprehensive review of the literature is not the purpose of this paper, a partial review of the principal English-language geographical journals published since 1950 supports this observation. The year 1950 marked a turning point for Asia, with the establishment of a communist government in China, the outbreak of the Korean War, the move toward independence of former colonial states, and the beginning of the modern development era for Asia. One will also find that the corpus of geographic literature on Asia dates largely from the post-1950 period.

It is not surprising that China and India have occupied the attention of a majority of the geographers concerned with Asia. These two states are the oldest in the region, in some respects the mother cultures for many of the other states of Asia, as well as the largest and most populous.[3] Secondary subregions of interest to geographers include Japan and Southeast Asia, especially Malaysia. Other states, such as Korea, Taiwan, Pakistan, and the Indochina states, are of relatively minor importance in the geographic literature.

Within these various subregions the topical focus of geographers has also shown distinct orientations. In general, Western geographers have tended to concentrate on studies of physical and historical geography, on regionalization systems, on population and agricultural patterns. Unfortunately, only a limited number of these studies offer data, ideas, or analyses likely to be of value to other scholars. This is certainly true in the case of China, as Murphey discovered in his 1973 review of the status of geographic studies on that country. He states: "If one is to be honest, much of what has been done by geographers is of only limited intellectual value and offers relatively little to other students of the area. The great bulk of it is purely descriptive, often elementary, often lacking in analysis, and often adding little or nothing to existing knowledge or presenting in simplified form information available elsewhere in the secondary literature" (Murphey 1973, p. 96). I think one could make the same general statement about geographic studies of other subregions of Asia. (Indeed, perhaps Murphey's description fits many of the regional studies published by American geographers!) As Murphey notes in the case of China, however, and as I would suggest is the case with the literature on the rest of Asia, there are exceptions to what seems a dismal situation. While it might be presumptuous to cite which are and which are not good examples of geographic research on Asia, one could note some of the studies in the post-1950 period that have dealt with problems at least related to real development issues. These studies are a minority, however, of the existing geographic literature on Asia. For instance, a number of geographers have looked at problems associated with urbanization and the cities of Asia (Fryer 1953; Murphey 1954; Breese 1963; Lai and Dwyer 1964; Neville 1966; Rose 1966; Lo 1968; Sternstein 1974; Doeppers 1974; Aiken and Leigh 1975; Ma 1976; Chang 1976). Agricultural issues have likewise been of interest to Western geographers, particularly food production, land use problems, and water supply issues (Trewartha 1950; Wiens 1951, 1967, 1969; Eyre 1955, 1962; Wikkramatileke 1965, 1972; Wikkramatileke and Singh 1970; C. Vander Meer 1968, 1971; Nath 1969;

Chakravarti 1970, 1973; Knapp 1971; Wilbanks 1972; Seavoy 1973; Harriss 1974; P. Vander Meer 1976). A few geographers have addressed themselves to problems of industry (Brush 1952; MacFadden 1954; Thompson 1959; Eyre 1963, 1965; Kinloch 1966; Chang 1970) and transportation problems (Ginsburg 1951; Chang 1961; Leinbach 1975). Political and military problems have concerned another limited group of geographers (Ginsburg 1952; Ahmad 1953; Mayfield 1955; Herman 1959; Fisher 1965, 1970, 1971; Zaidi 1966; Stephenson 1968; McColl 1969, 1975). Recent years have also seen the beginnings of recognition by geographers of recreation and wildlife management issues (Withington 1961; Robinson 1972; Greer 1976), as well as medical geography applied to Asia (Gajdusek 1956; Meade 1976) and the problem of environmental degradation (Fisher and Sargent 1975).

These are mentioned only as examples of development-oriented studies, not necessarily as illustrations of outstanding research that is likely to have an impact on other geographers or Asian specialists in other disciplines. Also, these represent the efforts of primarily American and British geographers. There are, of course, geographers in most of the countries of Asia who are quite active in studying their own and other nearby countries (Fuchs and Street 1971?), and it may be worth noting that the orientation of their research depends to a considerable extent on the political/social system in which they work. For example, geography in China has had a renaissance in the post-1950 period, but as several writers have recognized, the orientation of such research has been almost entirely in the area of physical and economic geography directly pertinent to national development problems (Murphey 1973; Kikolski 1964; Hsieh 1959; Chang 1975). Japanese geographers are among the most active in the profession within Asia, and their orientation likewise shows a strong bias toward physical geography, but with interest also in economic, urban, and social geography. The principal problem with most of the geographic research produced in Asian countries is that it is published for the most part in the Asian languages that very few Western geographers can read. Little of this research output is ever translated into English even though some of it is of first-rate quality.[4]

The apparent reasons for the relative neglect of Asia and the development problems of the region are diverse. In part, the lack of interest is characteristic of the decline in foreign area studies in geography in general. This has been due in turn to both the quantitative/theoretical trend in modern geography and the demanding nature of the field of regional studies, which rests on a complex integration of an area's language, culture, literature, and the work of scholars in many other disciplines. In addition, a regional geographer should also master one or more of the systematic specialties as well as have the same command of research and analytical techniques as others in the field. These formidable requirements have served to discourage many geographers in the West from specializing in the study of Asia. An additional factor that contributes to this neglect is the difficulty if not impossibility of field research in many parts of Asia. China stands out as the premier example in this regard, but other countries, such as India, also present problems for geographers and other scholars attempting field work. Another factor is the limited, in some cases nonexistent, data base for many parts of Asia. China again may be used as an example, but actually most of the Asian countries have relatively poor data-gathering capabilities, and much of the data reported is not always reliable. This problem is particularly vexing for the rare quantitative or theoretical geographer who does want to test his models in an Asian context. Given these difficulties, it is understandable why Western geographers tend to avoid Asia. But that does not make it excusable. Scholarly study is never an easy task. Moreover, paucity of hard data has not deterred Asian specialists in other disciplines from producing outstanding studies on development issues.

## *THE ISSUE OF DEVELOPMENT*

The theme of "development" has become widely adopted largely in the past quarter century primarily as a result of the end of colonialism and the large increase of the number of independent states in the world, many of them barely viable from an economic, political, or other perspective. In Asia only one of the twenty-five states has not been a colony or semicolony of the Great Powers (namely, Japan, which in fact was a colonial power itself). As de Souza and Porter (1974) pointed out in their study of underdevelopment in the Third World, attitudes toward and interpretations of what exactly constitutes "development" have changed markedly over the years. There is still no universally accepted definition, as evidenced in part by the multitude of terms often used in association with "development," such as "underdevelopment," "modernization," "Westernization," "industrialization," "economic development," and so on. Nevertheless, it does seem that the urban/industrial model of the West which guided the growth-dominated development strategies of the 1950s and 1960s is being viewed in a much different light in the decade of the 1970s. That model is based on the Western paradigm of maximizing the efficiency of certain economic aggregates like GNP at the expense of all other social aspects of development, and was adopted wholeheartedly by many countries of Asia. Rising to challenge that model of Western origin, in the minds of many people if not yet the development plans of most governments in Asia, is a model that for want of a better name could be called "Maoist" and which stresses real welfare for all the people as the only legitimate goal of economic growth. In other words, the issue of development is seen increasingly as involving not just the improvement of a country's economy to maximize production but the total utilization of a country's human and physical resources to maximize the real welfare of all the people within the context of indigenous values and systems. Between these two quite different interpretations of development is a broad range of issues.

## DEVELOPMENT PROBLEMS OF ASIA: POTENTIAL AREAS FOR GEOGRAPHIC RESEARCH

The range of development problems found within Asia is so great that it is difficult to categorize and summarize them. Obviously the specific problems vary in nature and intensity from country to country and between subregions. Nonetheless, there are at least a dozen major development themes or problems, each with numerous aspects, that warrant elaboration here. As will be quickly observed, these problems are all interrelated. Likewise, the universality of many of them can readily be seen.

### *National Unity and Political Viability*

If the thesis is correct that Asia is in the process of developing its own indigenous forms of government, it follows that the nature of those governments is subject to examination, for what is most needed in the states of Asia is the support of all the people, not just select groups. This can only be achieved by fair treatment of the populace. That such has not been the case is evident by insurrections, rebellions, and civil wars that have plagued Asia throughout the past quarter century and fester still in many areas, such as the Philippines, Malaysia, Thailand, Burma, and Indonesia. The contrast between the states of East Asia (China, Japan, Korea, Taiwan) and the rest of Asia in this regard is particularly striking and provides a potentially rich area of study.

### *Realistic Development Strategies*

As already indicated, the urban/industrial model does not fit well in the world of the 1970s. Modifications of, if not total substitutions for, that model are needed. Particularly from the geographic or spatial viewpoint, what is urgently needed in Asia is a more balanced development of each country's resources, to reduce rural/urban imbalances and achieve more rational distributions of people and modern economy.

### *Food Self-Sufficiency*

With their large and, in most countries, rapidly growing populations, the states of Asia have a critical problem of achieving or maintaining relative food self-sufficiency. The problems for study by the geographer are numerous in this area, including such issues as the limitations of the Green Revolution; the tremendous gap in unit area yields between Japan at the top and the many states at the bottom; the problem of changing diets with increased standards of living and the inability of many of these areas to provide the foods demanded in these changing diets; the question of how to achieve agricultural improvements, such as the commune system versus the private family farm still characteristic of most of Asia; and landscape modification to meet agricultrual needs. With Asia still predominantly an agricultural region, the problems for study in the area of food and agriculture are incredibly diverse and complex.

### *Overpopulation*

The population issue is another major problem in Asia, which contains the complete range of countries from those near zero population growth to others with virtually unchecked multiplication of their populations. A critical issue in Asia is how to institute truly effective family planning programs. Although many states have tried it, few have succeeded. Again, the relative success of the East Asian countries compared with the rest of Asia is intriguing. A subsidiary but still important issue is that of the extreme maldistribution of population in many of the countries, a reflection of their historical agricultural origins, as well as the colonial experience. There have been attempts to alter this uneven distribution, such as in Indonesia, which could be examined. Indeed, the migration and voluntary or involuntary redistribution of populations are a dramatic phenomenon of contemporary Asia.

### *Urbanization*

Too many people have moved too quickly to overcrowded and relatively unplanned cities, creating much of the human misery that is endemic in large parts of Asia. One of the paradoxes of the continent is that it is one of the least urbanized regions of the world, yet it contains a sizeable number of the world's largest cities. The total urban population of China, for example, is equal to half the population of Japan. China alone demonstrates not only some of the major urban problems facing Asia but more importantly also some of the most innovative and potentially most successful approaches to solutions of those problems.

### *Economic Nationalism*

Some people have come to question the dependence of many Asian states on other countries for trade, aid, and investment capital. This has led to the wide range of development strategies, from those states seeking self-reliance, such as China and Burma, to those accepting the necessity of such dependence, such as Taiwan and South Korea. The issue of economic nationalism is a powerful one, especially in the present-day world of growing scarcities of raw materials, the emergence of cartels, and the equally intense political nationalism widespread in Asia.

### *Industrialization Strategies*

Although many states now question the urban/industrial model of development, none are suggesting that they do not want any industrialization. Rather the question is becoming one of whether to emphasize heavy or light industry, to seek import substitution or export market manufacturing, to concentrate industry to maximize economies of scale or to disperse industry for more balanced regional growth. Here again there are great and fascinating contrasts in Asia, such as Japan's unique experience compared with China's quite different approach.

### *Economic Diversification*

A major problem facing the states of Southeast Asia particularly is their dependence on a few primary commodities for their principal export trade and the instability of the prices and markets for those commodities. Hence, there is a strong desire to diversify their economies, to try to establish cartels along the lines of OPEC, and to establish domestic manufacturing. A major aspect of this issue involves economic complementarity between these developing states and the industrialized countries they trade with. This is complicated by the fact that the developing states are all competing with one another in the same markets when they try to establish export manufacturing sectors.

### *Environmental Pollution/Degradation*

Most of the Asian countries have industrialized with little or no regard for the environmental consequences. This was in part a reflection of the unqualified embrace of the urban/industrial model with its emphasis on growth of the GNP rather than environmental management. Japan surely is a classic example of this condition. Although that country is now taking steps to correct the excesses of the past, it will be plagued for decades to come with the consequences of growth for growth's sake. There are numerous other Asian states, though, that are following in Japan's footsteps in terms of disregarding environmental abuses, seemingly oblivious to the lesson to be observed from Japan's experience.

### *Social Welfare*

Another group of issues involve social welfare. Here again Asia runs the extreme range, from countries where social welfare is apparently of primary concern to the government to those states where the individual must still rely on the family for welfare. The latter situation remains much more common. But efforts to improve social welfare, such as the unique public health program of China, with its paramedics and highly dispersed health care system and the blending of indigenous and modern medical practices, offer excellent research opportunities.

### *Regional Conflict*

Asia is a cauldron of regional conflicts, stemming in part from historical cultural hatreds and prejudices (such as those between the Japanese and Koreans, the Chinese and Malays, the Thais and Cambodians, the Indians and Pakistanis, and so forth). In addition, some active competition exists today in the cononomic sphere (such as the states of Taiwan, Hong Kong, and South Korea all competing for the same textile markets in the United States and Europe). This has all been further complicated by the conflicts resulting from big power intervention in the postwar era, typified by the quarter-century Indochina struggle, the ongoing divisions between China and Taiwan, North and South Korea. Much of this instability can be traced to the colonial legacy as well, when some states were artificially created as the colonial powers divided up the territory among themselves, often disregarding natural physical and ethnographic boundaries, as in the case of Indochina.

### *Regional Cooperation*

Within Asia there have been some efforts to promote regional cooperation, in some instances with participation of outside countries (such as the Mekong development scheme), and at others on a strictly internal basis. The most successful example of the latter, to date, is the Association of Southeast Asian Nations (ASEAN). A major question is why regional cooperation has not been more successful. Many of the reasons have been described previously, at least in part, but one could add such issues as territoriality and its extension in recent years and the potential impact on navigation (such as the Straits of Malacca), oil exploration, and fishing rights.

## *CONCLUSION*

Obviously many other themes and problems exist, but the major ones summarized previously are sufficient to demonstrate the wealth of research opportunities awaiting geographers concerned with Asia. The record of their interest in the past is not impressive. The future record could be better, and there are a few hopeful signs on the horizon. However, I suspect that the situation will not change drastically until the current cycle of national disinterest in Asia (and foreign areas in general) has run its course in government, in higher education, and in geography. The question is, should not geography, with its historical (although never fully realized) role as the great integrating discipline of the social and natural sciences, lead the way in the renaissance of interest in one of the world's most important regions rather than follow the mainstream? The opportunities for applied research in the development problems of Asia are virtually boundless. One of the rewards could be an overdue recognition by nongeographers of the work that geographers do. Another and more important benefit might be the contribution geographic studies could make to the solution of some of Asia's development problems.

## NOTES

1. This is a somewhat more narrowly defined "Asia" than some geographers are accustomed to perhaps, leaving out as it does Southwest Asia (which properly belongs with the Arab world and Middle East), as well as Soviet Siberia and Australia/New Zealand.
2. There may yet be some hope, as evidenced by the recent formation of the Committee on Asian Geography in the Association of American Geographers (AAG), which has met with an enthusiastic response.
3. This subregional emphasis is reflected in part by the activities of the Committee on Chinese Geography of the AAG, which has been in existence for some time (since the 1950s) but which has seen a renaissance in the past few years.
4. The Committe on Chinese Geography is attempting to rectify this problem, insofar as China is concerned, by plans to establish a journal of translations on the geography of contemporary China, consisting of translations of mainland Chinese publications, Japanese studies on China, and studies from Taiwan and Hong Kong.

## REFERENCES CITED

Ahmad, Nafis. "The Indo-Pakistan Boundary Disputes Tribunal, 1949-50." *The Geographical Review* 43 (July 1953) :329-37.

Aiken, S. Robert and Colin H. Leigh. "Malaysia's Emerging Conurbation." *Annals of the Association of American Geographers* 65 (December 1975) :546-63.

Breese, Gerald. "Urban Development Problems in India." *Annals of the Association of American Geographers* 53 (September 1963) :252-65.

Brush, John E. "The Iron and Steel Industry in India." *The Geographical Review* 42 (January 1952) :37-55.

Chakravarti, A. K. "Foodgrain Sufficiency Patterns in India." *The Geographical Review* 60 (April 1970) :208-28.

____. "Green Revolution in India." *Annals of the Association of American Geographers* 63 (September 1973) :319-30.

Chang, Kuei-sheng. "The Changing RR Pattern in Mainland China." *The Geographical Review* 51 (October 1961) :534-48.

____. "Nuclei-Formation of Communist China's Iron and Steel Industry." *Annals of the Association of American Geographers* 60 (June 1970) :257-85.

____. "The Geography of Contemporary China: Inventory and Prospect." *The Professional Geographer* 27 (February 1975) :2-6.

Chang, Sen-dou. "The Changing System of Chinese Cities." *Annals of the Association of American Geographers* 66 (September 1976) :398-416.

de Souza, Anthony R. and Philip W. Porter. *The Underdevelopment and Modernization of the Third World.* Commission on College Geography Resource Paper 28. Washington, D.C.: Association of American Geographers, 1974.

Doeppers, Daniel F. "'Ethnic Urbanism' and Philippine Cities." *Annals of the Association of American Geographers* 64 (December 1974) :549-59.

Eyre, John D. "Water Controls in a Japanese Irrigation System." *The Geographical Review* 45 (April 1955) :197-216.

____. "Mountain Land Use in Northern Japan." *The Geographical Review* 52 (April 1962) : 236-52.

____. "Industrial Growth in the Suwa Basin, Japan." *The Geographical Review* 53 (October 1963) :487-502.

____. "Japan's Electric Power Supply." *The Geographical Review* 55 (October 1965) : 546-62.

Fisher, Charles A. "The Vietnamese Problem in Its Geographical Context." *The Geographical Journal* 131 (December 1965) :502-15.

——. "Containing China? Part One: The Antecedents of Containment." *The Geographical Journal* 136 (December 1970) :534-56.

——. "Containing China? II. Concepts and Applications of Containment." *The Geographical Journal* 137 (September 1971) :281-310.

Fisher, Charles A. and John Sargent. "Japan's Ecological Crisis." *The Geographical Journal* 141 (July 1975) :165-76.

Fryer, D. W. "The 'Million City' in Southeast Asia." *The Geographical Review* 43 (October 1953) :474-94.

Fuchs, Roland J. and John M. Street, eds. *Geography in Asian Universities.* Honolulu: University of Hawaii, Department of Geography and Oriental Publishing Company, 1971?

Gajdusek, D. Carleton. "Hemorrhagic Fevers in Asia: A Problem in Medical Ecology." *The Geographical Review* 46 (January 1956) :20-42.

Ginsburg, Norton S. "China's Railroad Network." *The Geographical Review* 41 (July 1951) : 470-74.

——. "China's Changing Political Geography." *The Geographical Review* 42 (January 1952) : 102-17.

Greer, Charles. "The Management of Chinese Wildlife Resources: Policies, Practices, and Agencies." *Proceedings of the Association of American Geographers* 8 (1976) :122-24.

Harriss, Barbara. "The Role of Punjab Wheat Markets as Growth Centres." *The Geographical Journal* 140 (February 1974) :52-71.

Herman, Theodore. "Group Values Toward the Natural Space: The Case of China." *The Geographical Review* 49 (April 1959) :164-82.

Hsieh, Chiao-min. "The Status of Geography in Central China." *The Geographical Review* 49 (October 1959) :535-51.

Kikolski, Bohdan. "Contemporary Research in Physical Geography in the Chinese People's Republic." *Annals of the Association of American Geographers* 54 (June 1964) :181-89.

Kinloch, Robert F. "The Growth of Electric Power Production in Malaya." *Annals of the Association of American Geographers* 56 (June 1966) :220-35.

Knapp, Ronald G. "Marketing and Social Patterns in Rural Taiwan." *Annals of the Association of American Geographers* 61 (March 1971) :131-55.

Lai, David C. Y. and D. J. Dwyer. "Tsuen Wan: A New Industrial Town in Hong Kong." *The Geographical Review* 54 (April 1964) :151-69.

Leinbach, Thomas R. "Transportation and the Development of Malaya." *Annals of the Association of American Geographers* 65 (June 1975) :270-82.

Lo, C. P. "Changing Population Distribution in the Hong Kong New Territories." *Annals of the Association of American Geographers* 58 (June 1968) :273-84.

Ma, Laurence J. C. "Anti-Urbanism in China." *Proceedings of the Association of American Geographers* 8 (1976) :114-18.

McColl, Robert W. "The Insurgent State: Territorial Bases of Revolution." *Annals of the Association of American Geographers* 59 (December 1969) :613-31.

——. "Geopolitical Themes in Contemporary Asian Revolutions." *The Geographical Review* 65 (July 1975) :301-10.

MacFadden, Clifford H. "The Gal Oya Valley: Ceylon's Little TVA." *The Geographical Review* 44 (April 1954) :271-81.

Mayfield, Robert C. "A Geographic Study of the Kashmir Issue." *The Geographical Review* 45 (April 1955) :181-96.

Meade, Melinda. "Land Development and Human Health in West Malaysia." *Annals of the Association of American Geographers* 66 (September 1976) :428-39.

Mikesell, Marvin W., ed. *Geographers Abroad: Essays on the Problems and Prospects of Research in Foreign Areas.* University of Chicago, Department of Geography, Research Paper No. 152, 1973.

Murphey, Rhoads. "The City as a Center of Change." *Annals of the Association of American Geographers* 44 (December 1954) :349-62.

____. "Geographic Study of China." In Marvin W. Mikesell, ed., *Geographers Abroad.* The University of Chicago, Department of Geography Research Paper No. 152, 1973.

Nath, V. "The Growth of Indian Agriculture: A Regional Analysis." *The Geographical Review* 59 (July 1969) :348-72.

Neville, Warwick. "Singapore: Ethnic Diversity and Its Implications." *Annals of the Association of American Geographers* 56 (June 1966) :236-53.

Robinson, G. W. S. "The Recreation Geography of South Asia." *The Geographical Review* 62 (October 1972) :561-72.

Rose, John. "Hong Kong's Water Supply Problem and China's Contribution to Its Solution." *The Geographical Review* 56 (July 1966) :432-37.

Seavoy, Ronald E. "The Transition to Continuous Rice Cultivation in Kalimantan." *Annals of the Association of American Geograhers* 63 (June 1973):218-25.

Stephenson, Glenn V. "Pakistan: Discontiguity and the Majority Problem." *The Geographical Review* 58 (April 1968) :195-213.

Sternstein, Larry. "Migration to and from Bangkok." *Annals of the Association of American Geographers* 64 (March 1974) :138-47.

Thompson, John H. "Manufacturing in the Kita Kyushu Industrial Zone of Japan." *Annals of the Association of American Geographers* 49 (December 1959) :420-42.

Trewartha, Glenn T. "Land Reform and Land Reclamation in Japan." *The Geographical Review* 40 (July 1950) :376-96.

Vander Meer, Canute. "Changing Water Control in a Taiwanese Rice-Field Irrigation System." *Annals of the Association of American Geographers* 58 (December 1968) :720-47.

____. "Water Thievery in a Rice Irrigation System in Taiwan." *Annals of the Association of American Geographers* 61 (March 1971) :156-79.

Vander Meer, Paul. "Land Fragmentation Through Land Consolidation: Chulin Village, Taiwan." *Proceedings of the Association of American Geographers* 8 (1976) :35-37.

Wiens, Herold J. "Geographical Limitations to Food Production in the Mongolian People's Republic." *Annals of the Association of American Geographers* 41 (December 1951) : 348-69.

____. "Regional and Seasonal Water Supply in the Tarim Basin and Its Relation to Cultivated Land Potentials." *Annals of the Association of American Geographers* 57 (June 1967) : 350-66.

____. "Change in the Ethnography and Land Use of the Ili Valley and Region, Chinese Turkestan." *Annals of the Association of American Geographers* 59 (December 1969) : 753-75.

Wikkramatileke, Rudolph. "State Aided Rural Land Colonization in Malaya: An Appraisal of the F. L. D. A. Program." *Annals of the Association of American Geographers* 55 (September 1965) :377-403.

____. "The Jengka Triangle, West Malaysia: A Regional Development Project." *The Geographical Review* 62 (October 1972) :479-500.

Wikkramatileke, Rudolph and Karpal Singh. "Tradition and Change in an Indian Dairying Community in Singapore." *Annals of the Association of American Geographers* 60 (December 1970) :717-42.

Wilbanks, Thomas J. "Accessibility and Technological Change in Northern India." *Annals of the Association of American Geographers* 62 (September 1972) :427-36.

Withington, William A. "Upland Resorts and Tourism in Indonesia: Some Recent Trends." *The Geographical Review* 51 (July 1961) :418-23.

Zaidi, Iqtidar H. "Toward a Measure of the Functional Effectiveness of a State: The Case of West Pakistan." *Annals of the Association of American Geographers* 56 (March 1966) : 52-67.

# *The Past, Present, and Future of Computers in Geography*

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The use of electronic digital computers is becoming increasingly important in geography. In fact, there are several facets of the dicipline which have made major advances as a result of computer technology; these include optimal location selection, image interpretation, and cartographic production. With the increased emphasis on applied geography, it is likely that the computer will prove to be an even more important tool in the solution of geographic problems. This paper reviews the development of computer usage in geography, describes selected applications in current research, and suggests future needs of the dicipline as related to computers.

## *PAST*

Although the computer has been with us for more than twenty-five years, its use in geography has been generally restricted and unimaginative in comparison with many other disciplines. Psychology was one of the earliest users of computers within the "soft sciences," begun before 1950. Published accounts of geography's use of computers came several years later. Early uses of computers in geography were primarily those involved in the "quantitative revolution" which developed about the same time. Aside from the classic article by Kao in 1963, there was little in the literature of the late 1950s and early 1960s that specifically addressed the usage of computers. It is clear from the published research, however, that early computer use in geography was primarily related to statistical analysis, particulary correlation and regression. One of the first articles appearing in North American literature that mentioned the use of the computer as an analytical tool was that of Robinson and Bryson in 1957, discussing the results of a polynomial regression analysis which had been run of a computer. It is interesting to note that this came five years after Hägerstand's (1952) work on simulation, the first known computer application in geography. Tobler's experiments with digital incremental plotters in the late 1950s were some of the earliest examples of automated cartography.

The 1960s saw the greatest advances in computer usage in geography. By the start of this decade, many of the major universities in the United States had their own research computer; and ten years later all but the smallest of colleges had some access to computer facilities for research endeavors. The problem of that decade, especially in geography, was one of training. A few of the more progressive geography departments were training their students in the use of individual canned programs for statistical analysis; a few encouraged students to learn computer programing; and by the end of the decade students were gaining some experience with early computer mapping routines, particularly Fisher's SYMAP. However, specific computer training was not yet being required or even encouraged by most institutions, and thus the "new" geographers of the day were almost as nonconversant with computers as their predecessors.

One factor which helped to encourage the use of computers in geography during this time was the ready availability of the 1960 U.S. Census information in machine readable form. Magnetic tapes could now be purchased containing the information found on hundreds of thousands of punched cards; and for the first time large amounts of demographic, social, and economic data became readily usable to the academic researcher. Geographers, as well as other social scientists, took advantage of this data availability, which necessitated the use of computers for retrieval and processing.

One of the more significant contributions in computer applications for the spatial sciences in the 1960s was the publication of the Kansas Geological Survey *Computer Contributions* series. This collection of monographs detailed computer software that was particularly applicable for the manipulation, portrayal, and analysis of spatial data. Although oriented to geologists and written largely by geologists,this set of publications was pioneering in its dissemination of computer-related information in the spatial sciences. This type of effort was enhanced late in the decade when first Northwestern University published a set of their geography computer programs (Marble 1967) and then the University of Iowa published a similar document (Wittick 1968).

An additional catalyst at this time for disseminating computer-related information in geography was the NSF-sponsored conferences on quantitative geography organized by Northwestern University. The conferences brought together the recognized quantitative geographers of the time who exchanged information concerning their own work, much of it using the computer in one way or another. Of these conferences the one which had the most significant impact on computer development in geography, held at Minneapolis in June of 1970, was devoted exclusively to discussions of computer applications in geography. Besides the usual exchange of information, two additional developments occurred which became instrumental for the dissemination of computer knowledge within the discipline.

The conference participants agreed that the diffusion of computer knowledge and application was proceeding too slowly in geography. Except for the two previously noted departmental computer manuals, there was no vehicle at the time for disseminating this type of information. It was agreed that a newsletter should be published to further this information exchange. Forest Pitts accepted the editorship and incorporated the newsletter within the *Current Research Notes in Quantitative and Theoretical Geography*, published by the International Geographical Union.

It was also felt that there was a need for a centralized clearinghouse for software dissemination in geography. It would be the purpose of this organization to collect nonproprietary software specifically related to the analysis, description, and portrayal of spatial data and then make it generally available on a minimal cost basis. The Computer Institute for Social Science Research at Michigan State University agreed to house and support this operation, which later was named the Geography Program Exchange (GPE). Through a grant from the Mathematical Social Science Board, the GPE was able to begin operation early in 1971. Today it is still actively performing its functions on a self-sustaining basis. Although the structure and operation of the GPE are detailed in other papers (Wittick 1973; Marble and Wittick 1976), it is worth noting here that the general trend of dissemination by the GPE has been from the larger Ph.D.-granting, research-oriented universities to the smaller universities and colleges, first in North America and later in Europe. In fact, the GPE became so successful in Europe that in 1974 a European branch was established in Switzerland and later resituated in West Germany. It appears, then, that the GPE has succeeded in diffusing the computer capabilities of a few pioneering geography departments throughout the discipline in a relatively short period of time.

Several other events of the early 1970s helped to increase the use and applicability of computers in geography. These included the publication of Tobler's (1970) computer programs, the introduction of new programs by the Laboratory for Computer Graphics and Spatial Analysis, and the publication by Tarrant (1971) listing the program holdings of geography departments around the world. It was obvious from Tarrant's work that most departments with computer capabilities at this time were primarily concerned with statistical analysis, particularly regression and factor analysis, and with computer mapping via SYMAP.

One recent contribution to the dissemination of computer knowledge in geography is the inventory of spatial analysis software commissioned by the United States Geological Survey and carried out by the Commission on Data Sensing and Processing of the International Geographical Union (1976). This effort, begun in 1974, abstracts all known proprietary and nonproprietary software available in the world which is designed for the manipulation of spatial data. It includes everything from geographic information systems to subroutines for polygon manipulation.

Throughout this review of the historical development of computers in geography, the basic research aspects of the discipline have been emphasized. What about applied geography? What were the trends in computer usage for this segment of the field? Unfortunately, the professional literature does not document these efforts well. Much of the material relating to this type of computer usage appears in such obscure sources as contract final reports, private corporation in-house documents, and government memoranda. That which is available, however, suggests that computer use in applied geography has closely followed the use in basic geographic research and, more importantly, emulated the work of allied disciplines such as applied statistics, regional science, and civil and industrial engineering. Government agencies, particularly at the Federal level, have been using computers as storage and retrieval devices for geographic research for some time, but only in the last few years have they begun to utilize the spatial analytic capabilities of automation.

Perhaps the most applied aspects of computer utlization in geography have been in the area of geographic information systems. This topic was first treated in the basic research literature of the mid 1960s. Several attempts were made to develop generalized geographic information systems (Dueker 1966; Wittick 1972), but their utility is clearly in the applied areas of the field. The development of the Urban and Regional Information Systems Association in the late 1960s did much to further this cause. It is interesting to note, however, that even today the number of operational geographic information systems is small, their structures are dissimilar and fragmented, and the state of the art in this area is still quite primitive.

## *PRESENT*

Where are we with computer utlization in geography as of 1977? As evidenced by the most recent edition of Tarrant's compilation, geography is still a discipline whose computer utilization is dominated by multivariate statistics and SYMAP. While this may characterize the predominate usage, there are some innovative and interesting applications within the discipline that merit attention. This section will focus on four of these applications.

The field of operations research offers numerous potential applications for geographic research, and the nature of this methodology almost invariably requires the use of computers for solution. Perhaps the most geographic of the operations research problems is the location-allocation model, whose origin can be traced back to the transportation problem of linear programing. The goal of a location-allocation model is to determine optimum locations for facilities, either private or public, given a set of constraints. These may be expressed in terms of costs (economic or social), time expended in travel, or distance traveled. The model determines the optimum location for the facility or facilities under consideration while insuring that the imposed constraints are not violated. This type of problem has been researched by Scott (1971), Rushton (1973), and ReVelle (1970), among others.

As an example of this kind of problem, let us assume that a community has the funds to build three new outpatient health clinics. These are to be located at places of greatest convenience to the citizens of the community. But this locational decision is not a trivial one because the population is dispersed throughout the area. It may be decided that no one in that community should be more than twenty minutes' driving time from a clinic or perhaps less than ten miles from any one of the facilities. A location-allocation model is ideally suited to solving this kind of problem, and the computer is an integral part of that solution.

Another interesting application in geography is the work currently being done with satellite data. This is best illustrated by the efforts of the Geography Branch of the United States Geological Survey, which has been generating land use maps directly from the digital signals received from the Landsat satellite. In effect, it is now possible to go directly from satellite radio transmission to color choropleth maps depicting land use without any intermediate photo interpretation.

Unfortunately, this process is not feasible using ordinary computer equipment. The USGS' efforts involve the use of the ILLIAC IV parallel processor, which involves more than eight minutes of computer time. The same work carried out on a typical university research computer would take between twenty-five and thirty hours of computer time. Nonetheless, with improvements in the algorithms used and equipment available, it will soon be possible to perform this type of interpretation on a routine basis.

Another computer mapping application that warrants attention is the system developed for the ECHO (Evidence for Community Health Organization) Program under the guidance of the Office of Health Services Education and Research in the College of Human Medicine at Michigan State University. For this project a system was developed which gave nonprofessionals, typically office clerks, the ability easily to construct computer maps depicting health-related statistics. The clerk simply uses an interactive terminal connected to MSU's computer (the terminals are normally situated in the Flint/Genesee County Health Department) while responding to a set of simple questions posed by the computer related to data requirements, area to be mapped, and characteristics of the map to be produced. The computer then produces the requested map.

This system is, in fact, a minigeographic information system in that it contains the necessary geographic base files, the health data, the analytic software, and the necessary interface for the intended user. While this system may not be as innovative as the USGS land use mapping capability, it is extremely practical and clearly demonstrates how problems in applied geography can take advantage of computer technology.

One of the largest efforts in the area of applied geography which uses a computer is the Canadian Geographic Information System (CGIS). This is a land use information system originally designed to provide extensive retrieval and manipulative capabilities for the Agricultural and Rural Development Administration of Canada (Tomlinson 1967). The system is now under the sponsorship of Environment Canada (Tomlinson 1973). CGIS includes data on the suitability of land for various uses, including agriculture, forestry, recreation, and wildlife habitat, as well as data concerning the present use of the land. Coverage includes most of southern Canada from the Atlantic to the Pacific. In addition to the land use data, the system also contains census data, administrative, watershed, and shoreline boundaries. The capabilities of the system include aggregating data for specific areas and comparing physical and socioeconomic characteristics.

The system provides land use information on an irregular polygon basis rather than the more common grid cell approach. This means the system contains very detailed locational information regarding the boundaries of the land use categories; however, it also requires much more geocoding and storage of geographic base file information. To illustrate the efficiency with which the process is accomplished, CGIS can store the total graphic and descriptive content of 600 average density maps (the majority of which are 1:50,000) of present land use on two reels of magnetic tape. Since the system contains information on more than 20,000 map sheets, plus the corresponding census data, this still represents a tremendous data storage and retrieval system.

## *FUTURE*

These four examples of current computer usage in geography are all within the broad area of applied geography. Unfortunately, they are not typical examples. As noted earlier, geography's use of computers has been, and still is, generally unimaginative and restricted; and unless steps are taken to change it, the same usage trend will continue in the future. What can we as geographers do to insure that computers will be more effectively used in future applied geographic studies? It seems to me that the answer involves three components. First, and most important, is the need for increased computer education. Future geographers should become better trained in the automated processing of information. Second, we need better equipment and easier access to computers than is presently available. This is less of a problem in academia than it is in government and private industry. Finally, we need a closer liaison between the potential employers of applied geographers and the academicians training these people. The employers must be made aware of the capabilities of our students, particularly with respect to technical expertise. In addition, the employers should be made aware of the advantages of hiring a geographer with computer talents instead of a computer science student with no appreciation for the geographic perspective.

One of the real problems for those working in applied geography today is the inadequacy or total lack of equipment or access to it; this is particularly a problem at the state and local government levels, and to a lesser extent in private industry. The future of computers is in interactive processing, and those using computers must have the equipment for this type of interaction. Thus, terminals must be provided for the applied researcher along with the requisite hardware and software to support them. For those of us in the discipline who are designing generalized spatial data systems, we must provide for these capabilities and insure that the systems are designed to take full advantage of this mode of interaction. For those involved in the equipment procurement process, interactive systems and supporting peripherals should receive careful consideration.

Given the computer's present role in applied geography and its anticipated future role, how can we best prepare the student who desires to pursue this aspect of the discipline? An obvious first step is a thorough grounding in the tools he will need for this work: cartography, remote sensing, field techniques, location analysis, and quantitative methods. Since several of these tools are now and will be increasingly dependent upon computer processing, a basic understanding of computer capabilities is also important. This does not mean merely a course in FORTRAN programing or experience using the SYMAP program. Neither of these by themselves will do much to give the student an appreciation of the computer's capabilities, regardless of the area of application. On the other hand, we do not want to make computer scientists out of our students either.

What we should strive for is a computer education that will give the student a knowledge of what the computer can do, how to design software systems necessary to do it, and how to organize data to take advantage effectively of the machine's capabilities. It doesn't matter whether the task is related to automated mapping, location analysis, image processing, or quantitative methods; these same computer basics are needed for every potential computer application in geography.

There are several approaches to this type of education. One is for the student to take a series of computer science courses. This is not usually the best approach, however. Computer science departments tend to be either too theoretical for those interested in applications or too data-processing oriented—how to learn twenty-seven different programing languages. Two other alternatives are either to teach the necessary material within the geography department as separate computer applications courses or to integrate the material into the appropriate courses that already exist. Given the nature and extent of material to be covered, it is preferable to develop one or more computer applications courses.

It is my opinion that all students being trained as applied geographers should be given a two-semester course in geographical data structures and processing systems. This course would be in addition to any given in the technique areas such as quantitative methods or computer mapping. Rather than teach computer programing or the use of canned programs, which is what most current computer-related courses in geography emphasize, this course should concentrate on the concepts of computer architecture, systems design, and spatial data structures.

The material covered in the architecture section should emphasize how computers function; an evaluation of those variables that determine the speed, capacity, cost, and utility of computers; and basic considerations of peripherals as data storage devices. The systems design section ought to focus on geographic information systems: what they are, how to design them, and characteristics of existing systems. The data structures portion of the course should describe the various types of data and geocodings used by geography, cost-benefit analyses of different structures, strategies for storing and updating data sets, and techniques for spatial data aggregation.

This set of courses would give the student the essential concepts necessary to plan the computer aspects of an applied geography research project and guide those aspects through to completion. It would not provide the student with all the computer expertise required to do the programing. Programers can be used for that. The intent of the courses should be to give the student a basic understanding of the machine and its capabilities, an ability to design the needed systems, and a knowledge of the character and peculiarities of spatially oriented data. Without these concepts, the automated processing of information will continue to be an enigma to the applied geographer and of little practical value.

## *REFERENCES CITED*

Commission on Geographical Data Sensing and Processing, International Geographical Union. *Computer Software for Geographical Data Handling,* Version 5. Amherst, New York: Geographic Information Systems Laboratory, State University of New York at Buffalo, 1976.

Dueker, Kenneth J. *Spatial Data Systems.* Urban and Transportation Information Systems technical report no. 5. Evanston, Ill.: Department of Geography, Northwestern University, 1966.

Hägerstrand, Torsten. *The Propagation of Innovation Waves.* Lund Studies in Geography, Series B, No. 4. Lund, Sweden: Gleerup, 1952.

Kao, Richard C. "The Use of Computers in the Processing and Analysis of Geograhic Information." *The Geographical Review* 53 (1963) :530-47.

Marble, Duane F. and Robert I. Wittick. "Development of an Operational Technology Trans-Department of Geography, Northwestern University, 1967.

Marble, Duane F., and Robert I. Wittick. "Development of an Operational Technology Transfer Center Within Geography." Paper presented at the International Geographical Congress, Moscow, U.S.S.R., July 1976.

ReVelle, Charles et al. "An Analysis of Private and Public Secotor Location Models." *Management Science* 16 (1970) :692-707.

Robinson, Arthur H. and Reid A. Bryson. "A Method for Describing Quantitatively the Correspondence of Geographical Distributions." *Annals of the Association of American Geographers* 47 (1957) :379-91.

Rushton, Gerard et al. *Computer Programs for Location-Allocation Problems,* Monograph no. 6. Iowa City: Department of Geography, University of Iowa, 1973.

Scott, Allen J. *Combinatorial Programming, Spatial Analysis and Planning.* London: Methuen, 1971.

*SYMAP Users Reference Manual.* Cambridge, Mass.: Laboratory for Computer Graphics, Harvard University, no date.

Tarrant, John R. *Computers in the Environmental Sciences.* Norwich, England: School of Environmental Sciences, University of East Anglia, 1971.

Tobler, Waldo R. *Selected Computer Programs.* Ann Arbor: Department of Geography, University of Michigan, 1970.

Tomlinson, Roger F. *An Introduction to the Geographic Information System of the Canada Land Inventory.* Ottawa: Department of Forestry and Rural Development, 1967.

______. *A Technical Description of the Canada Geographic Information System.* Ottawa: Environment Canada, 1973.

Wittick, Robert I. "Department of Geography Manual of Computer Programs," Special Publication no. 1. Iowa City: Department of Geography, University of Iowa, 1968.

______. "The Development of an Integrated Geographic Information System." Ph.D. dissertation, the University of Iowa, Department of Geography, 1972.

______. "The Geography Program Exchange: Present Operations and Future Goals." In Mark S. Monmonier, ed., *Computer Applications in Geography.* Albany: Department of Geography, State University of New York at Albany, 1973.

# *The Development of Black and White Two-Variable Maps: Ongoing Cartographic Research*

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Perhaps the most obvious aspect of cartography is production, the actual making of maps. Although production cartography yields the most visible results, the construction of the map itself is based largely on preexisting cartographic research. Cartographic research involves three principal categories (Figure 1): (1) map author input, (2) the map channel, and (3) map reader output. In other words, the map author puts information into a map, the map carries the information through space and time, and the reader extracts information from the map. Cartographic research is directed toward improving maps as clear channels of communication in which, ideally, author input is reproduced identically as output in the map reader's mind.

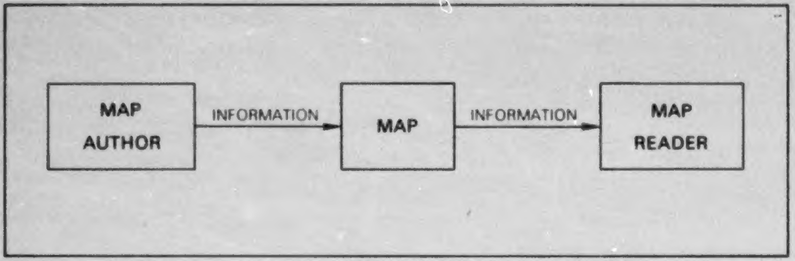


Figure 1. Channel of Cartographic Communication

This report reviews cartographic research on two-variable mapping techniques that is being conducted at the Michigan State University Center for Cartographic Research and Spatial Analysis. The first part explains the two-variable mapping concept, the second describes how the problem was identified, and the third section outlines how the research was designed and conducted. Finally, the preliminary results of the research are summarized.

## *TWO–VARIABLE MAPS*

Conventional choropleth maps generally show the distribution of a single variable among a set of areal units. The variable is usually expressed in ratio form: population per square mile, median family income, or agricultural yield per acre. The areal units might be minor civil divisions, states, nations, or, perhaps, an artificially imposed grid system. In the making of a choropleth map, values are first separated into classes. The classes are assigned pattern or color symbols which by their hues and intensities logically suggest high or low value. These symbols are then applied to the appropriate areal units.

Map 4 of the U.S. Bureau of the Census Technical Paper 37 (1975, p. 98) shows the average size of farms in the 3,000 U.S. counties (within the 48 contiguous states) symbolized by yellow and three tints of red.[1] On this map yellow indicates those counties where the average size of farms is less than 50 acres. Farms averaging 50 to 199 acres are represented by light red. Medium red represents counties where farms average 200 to 499 acres, and dark red indicates farms averaging 500 acres or more in size. This one-variable map shows the geographic clustering of farms of varying sizes. Map 5 of the U.S. Bureau of the Census Technical Paper 37 (1975, p. 99) shows through the use of color the average monetary value of all agricultural products sold per farm. On the map the yellow indicates counties in which farms average less than $5,000 worth of products sold. Light blue represents average sales of $5,000 to $19,999. Medium blue represents counties with sales of $20,000 to $39,999, and dark blue reflects average sales of $40,000 or more. Both of these are examples of one-variable maps.

Two-variable maps show the relationship between two variables. In a design of a coding system for showing this relationship, the three primary colors—red, blue, and yellow—may be used. These primary colors relate to the color spectrum in a specific way (Figure 2). Two vertical bars of yellow and red blended with two

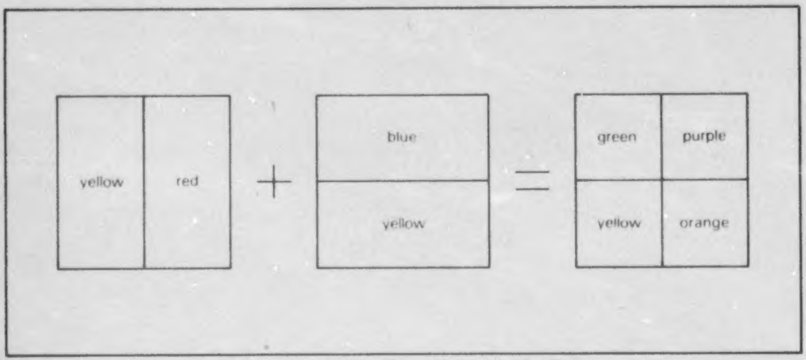


Figure 2. Color Two-Variable Coding

horizontal bars of yellow and blue produce four squares of yellow, purple, orange, and green. This coding scheme, devised by the U.S. Bureau of the Census (1975, p. 95), provides the basis for mapping the relationship between two variables consisting of two classes each. For example, a hypothetical variable X may be symbolized by yellow for Class I and red for Class II (the higher class). Variable Y can then by symbolized by yellow for Class I and blue for Class II. If the color symbols for variables X and Y are blended as previously described, the resultant colors indicate the relationship between the two variables:

1. Yellow: the values for both X and Y fall into Class I.
2. Purple: the values for both X and Y fall into Class II.
3. Orange: the value for X falls into Class II (high) and Y falls into Class I (low).
4. Green: the value for variable X falls into Class I (low) and that for variable Y is in Class II (high).

This scheme may be expanded by using the same colors but by separating the vertical red bar into three tints of red and the horizontal blue bar into three tints of blue. The colors of the vertical and horizontal bars are blended as before, creating a 4 x 4 matrix made up of sixteen squares of different colors and tints. In the corners of the matrix appear the same yellow, purple, orange, and green squares that were generated by blending the two vertical and horizontal bars of primary colors. The basic difference between the four-color matrix and the sixteen-color matrix is that additional tones are created when red and blue are separated into several tints. Whereas the 2 x 2 matrix allows the symbolization of the relationship between two variables with two classes each, the 4 x 4 matrix offers the capability of mapping the relationship between two variables with four classes each. Figure Map 6 of the U.S. Bureau of the Census Technical Paper 37 (1975, p. 100), a two-variable map produced by the Bureau of the Census, clearly illustrates that the size of farms and the average value of produce sold are not necessarily related.

## *HOW THE PROBLEM WAS IDENTIFIED*

Color two-variable maps may provide an effective vehicle for cartographic representation, but there are problems in producing them. Because they are full-color maps, they are both time consuming to construct and expensive to print. For example, at this time 1,000 copies of an 11" x 17" map can be printed in black and white for less than $50. One thousand copies of a full-color map at the same size would cost more than $1,000. In addition to printing costs, the equipment and knowledge required to prepare full-color maps are not available in many small cartographic laboratories. Even those cartographers who do possess the knowledge, equipment, and finances for producing color two-variable maps will find that few scientific journals accept color illustrations. Full-color, two-variable maps may be within the means of the Bureau of the Census, but they are beyond the financial and technological resources of many cartographers. Because of these problems, researchers at the MSU Center for Cartographic Research decided to investigate alternative methods for making two-variable maps. This research has been directed toward finding a method for constructing inexpensive black and white maps which clearly show the relationship between the distribution of two variables.

In the existing literature dealing specifically with two-variable maps are found *general discussions of the two-variable concept* (Meyer, Broome, and Schweitzer 1975, pp. 100-17; U.S. Bureau of the Census 1975, pp. 89-103) and a study dealing with color coding (Olson 1975). In the literature of medical geography Learmonth and Pal (1959, pp. 145-50) outline a method for constructing black and white two-variable maps. Their design does not clearly show the relationship between variables (Figure 3), and because the coding scheme lacks logic, the map reader is forced to make numerous visual journeys between the map and the legend.

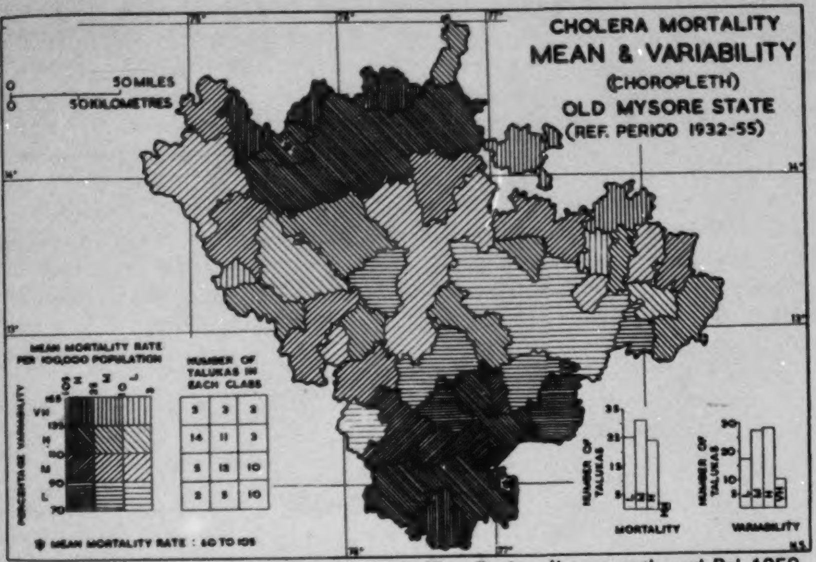

CHOLERA MORTALITY
MEAN & VARIABILITY
(CHOROPLETH)
OLD MYSORE STATE
(REF. PERIOD 1932-55)
50 MILES
50 KILOMETRES
MEAN MORTALITY RATE PER 100,000 POPULATION
PERCENTAGE VARIABILITY
VH
H
M
L
NUMBER OF TALUKAS IN EACH CLASS
3 3 2
14 11 3
5 13 10
2 5 10
MEAN MORTALITY RATE : 60 TO 105
NUMBER OF TALUKAS
MORTALITY
VARIABILITY

Figure 3. Black and White Two-Variable Map Design (Learmonth and Pal 1959, p. 147)

In noncartographic literature where two-variable maps appear, the same lack of coding logic limits map effectiveness. Two examples are Figure 4 (Groves 1974, p. 273) and Figure 5 (Abler, Adams, and Gould 1971, p. 159). A map which appears in *The Cooking of Italy* (Root 1968, p. 35) shows the relationship between the shape of noodles and the nature of cooking oils. Although the map is most interesting and inventive, it uses color.

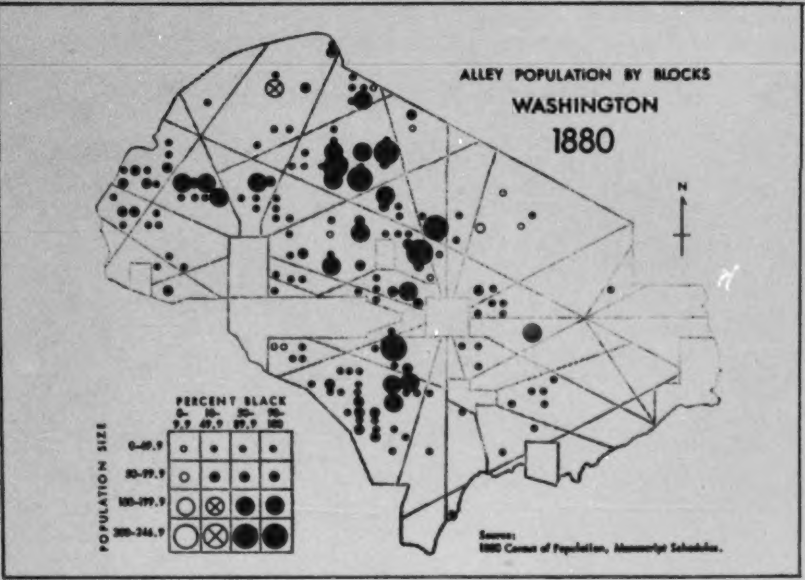

ALLEY POPULATION BY BLOCKS
WASHINGTON
1880
N
PERCENT BLACK
0-9.9
10-49.9
50-89.9
90-100
POPULATION SIZE
0-49.9
50-99.9
100-199.9
200-246.9
Source:
1880 Census of Population, Manuscript Schedules.

Figure 4. Black and White Two-Variable Map Design (Groves 1974, p. 273)

The U.S. Bureau of the Census, the source of most of the recent activity on two-variable mapping, is in agreement with the Center's conclusion: the problem of making effective two-variable maps in black and white has not been satisfactorily solved to date.

## *THE RESEARCH*

Several points needed to be considered before beginning the testing.

1. In the construction of effective, easily interpreted maps, any coding system using black and white symbols must be logical. This allows the map reader to interpret the map without constantly referring to the legend.
2. Psychophysical research suggests that the human brain is probably incapable of differentiating the sixteen black and white symbols in a 4 x 4 matrix (Williams 1958, pp. 132-39), but the nine symbols in a 3 x 3 matrix appear to be distinguishable.
3. In order to be effective, any design should show, with a minimum of reader effort, (a) the range of highly correlated variables and (b) residuals.
4. Examination of the nature of black and white symbols shows that they can be varied in only three respects:
   (a) Style—for example, line patterns, dot patterns, and those fashioned with irregular or specialty symbols.

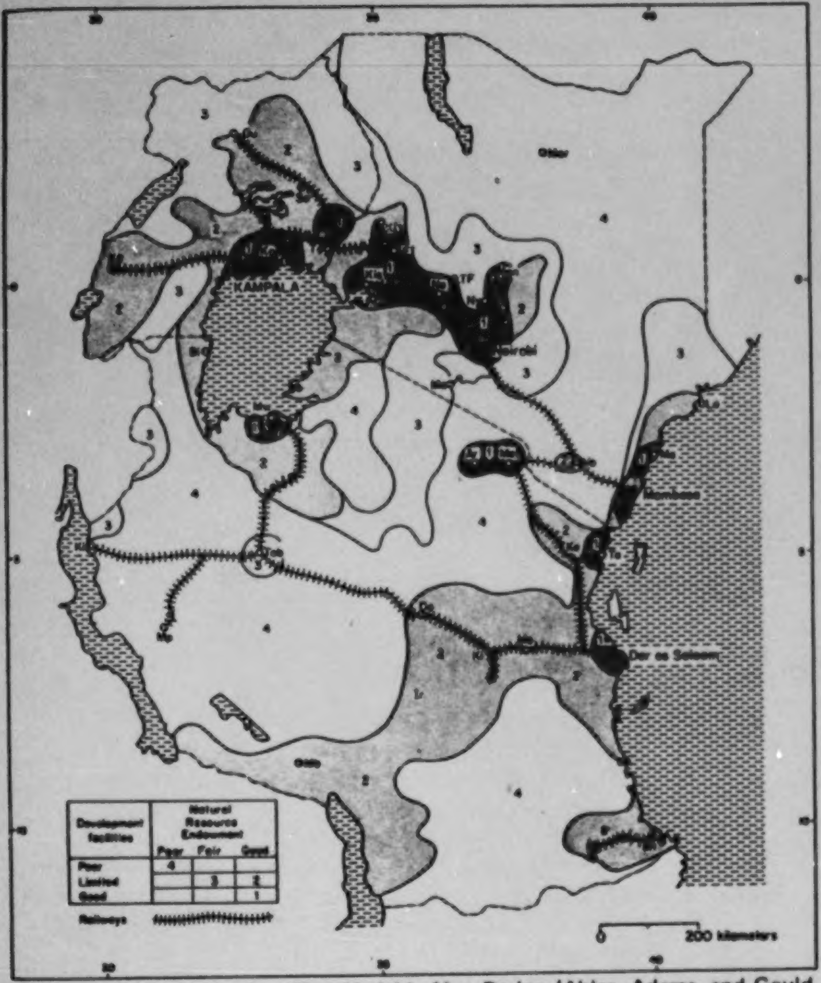

KAMPALA
Nairobi
Mombasa
Dar es Salaam
Development facilities
Natural Resource Endowment
Poor
Fair
Good
Poor
Limited
Good
4
3
2
1
Railways
0
200 kilometers

Figure 5. Black and White Two-Variable Map Design (Abler, Adams, and Gould 1971, p. 159)

(b) Value, lightness or darkness—lines per inch may remain constant, but the width of the lines are varied.

(c) Texture or coarseness, measured, for example, by the number of "lines per inch."

Based on this information about black and white symbols, decisions were made to reduce the range of alternatives for coding. The style would be limited to dots and lines, because these are the most widely available to cartographers. Value would be varied for one symbol and texture for the second.

A peelcoat with ten windows was prepared in order to determine easily distinguishable series of symbols for value. The dimensions of each window were consistent with the size of one row of squares in the 3 x 3 grid utilized throughout the study. Photographic exposures were made through the windows using a series of ten graded screen tints. Sixty-five-line dot screens were selected because (1) they would be within the capabilities of most printers and because (2) 65-line, adhesive-backed dot patterns in a wide range of values are available commercially under brand names such as Zipatone and Formatt. The exposed photographic paper was developed and a rectangular "chip" was cut out for each of the ten values. After an examination of different combinations of three chips, easily distinguishable, equal-appearing pattern intervals were selected visually.

The procedure for selecting texture symbols was similar to that used for value except that *transparent* film-positive chips were prepared using line screens. This also provided a convenient method for assessing the blending of value and texture by the placement of transparent texture patterns over the opaque value patterns. The selection of texture patterns was much more difficult since the number of lines per inch depends on the size of the areal units. Generally, the smaller areal units require finer patterns. Because of this, it is not appropriate to propose any firm procedure for determining texture patterns. Trial and error seem to yield the best results as long as coarser-appearing textures are selected to represent higher data values.

A sample 3 x 3 legend was prepared better to assess the effects of blending value and texture selections. This required (1) scribing the 3 x 3 matrix, (2) preparing four peelcoats, and (3) making five separate exposures on photographic paper using screens which matched the value and texture selections. One exposure was for 100 percent black (the outline of the legend); two were for value (horizontal); and two were for texture patterns (vertical). Neither Class I for variable X nor Class I for variable Y were exposed (see Figure 6).

The final analysis used the sample legend in a black and white, two-variable map in order to determine the effectiveness of the design in conveying information to the map reader (Figure 7). The average size of Michigan farms and the mean value of products sold per farm were arbitrarily chosen as test variables. The data were classed using standard deviations and iterating to reduce classing error (Jenks and Caspall 1971, pp. 217-44). Four peelcoats were prepared from a scribed base map of Michigan. A map was produced from five exposures onto Kodaline photographic paper.

## CONCLUSIONS

The design employed with the test map is judged to be an improvement on other two-variable black and white maps. It does, however, contain some visual

| Class | Variable Y (Value) | Variable X (Texture) |
|---|---|---|
| I | 0% | Open |
| II | 30% | Fine |
| III | 70% | Coarse |

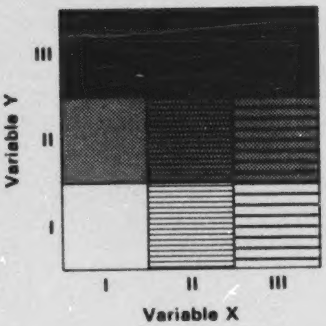


Figure 6. Black and White Two-Variable Coding

interference, or "noise," which may be reduced through further experimentation and refinement. In one respect, it is superior to full-color, two-variable maps. With the black and white design, it is possible to make interpretations regarding (1) the size of farms—symbolized by varying texture, (2) the average value of agricultural products sold—symbolized by variations in value, and (3) the relationship between the two variables—symbolized by the blend of value and texture. The only interpretation which may be easily made from color two-variable maps is the relationship between variables, since, when colors are blended, the character of the two original colors is lost.

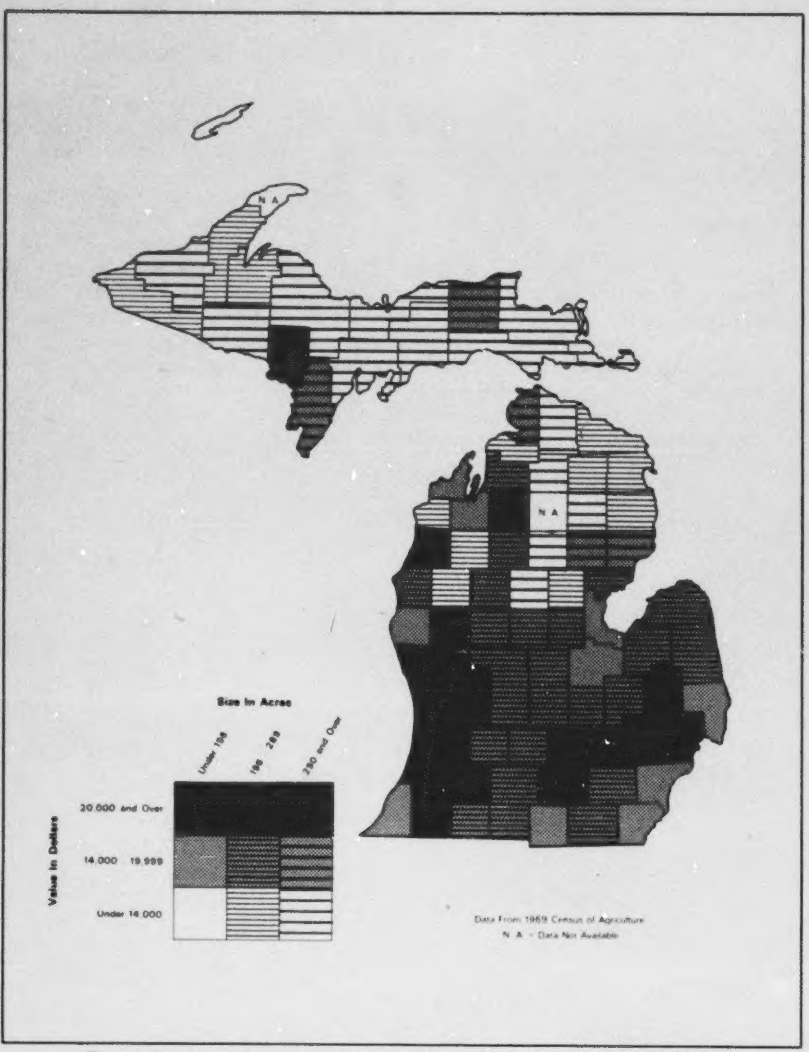
Although scribing, peelcoats, screen tints, and multiple exposures were used in preparing the test map, it may be duplicated by drafting in ink and applying adhesive patterns. Thus, this method is low in cost and may be employed by any competent cartographer using widely available materials and conventional drafting procedures.

## *ACKNOWLEDGEMENTS*

The author gratefully acknowledges the assistance of Gary K. Alden and James M. Larson in the preparation of this paper.

## *NOTE*

1. The production of this publication does not allow for the use of color illustrations. For this reason the reader may refer to the following publications that contain examples of color illustrations described in this paper: U.S. Bureau of the Census, *The Census Bureau: A Numerator and Denominator for Measuring Change,* Technical Paper 37 (Washington, D.C.: U.S. Government Printing Office, 1975); and Waverly Root, *The Cooking of Italy* (New York: Time-Life Books, 1968).


N A
N A
Size In Acres
Under 196
196 289
290 and Over
Value In Dollars
20,000 and Over
14,000 19,999
Under 14,000

Data From 1969 Census of Agriculture
N. A. = Data Not Available

Figure 7. Experimental Black and White Two-Variable Map Design

## *REFERENCES CITED*

Abler, Ronald, John S. Adams, and Peter Gould. *Spatial Organization: The Geographer's View of the World.* Englewood Cliffs, N.J.: Prentice-Hall 1971.

Groves, Paul A. "The Hidden Population: Washington Alley Dwellers in the Late Nineteenth Century." *The Professional Geographer* 26 (August 1974) :2.

Jenks, George F. and Fred C. Caspall. "Error on Choroplethic Maps: Definition, Measurement, Reduction." *Annals of the Association of American Geographers* 61 (June 1971) : 217-44.

Learmonth, A. T. A., and M. N. Pal. "A Method of Plotting Two Variables (Such as Mean Incidence and Variability from Year to Year) on the Same Map, Using Isopleths." *Erdkunde* 13 (1959) :145-50.

Meyer, Morton A., Frederick R. Broome, and Richard H. Schweitzer. "Color Statistical Mapping by the U.S. Bureau of the Census." *The American Cartographer* 2 (1975) : 100-17.

Olson, Judy M. "The Organization of Colors on Two Variable Maps." Paper presented at the International Symposium on Computer-Assisted Cartography, AUTO-CARTO II, Reston, Virginia, September 1975.

Root, Waverly. *The Cooking of Italy*. New York: Time-Life Books, 1968.

U.S. Bureau of the Census. *The Census Bureau, A Numerator and Denominator for Measuring Change*. Technical Paper 37. Washington, D.C.: U.S. Government Printing Office, 1975.

Williams, R. L. "Map Symbols: Equal Appearing Intervals for Printed Screens." *Annals of the Association of American Geographers* 48 (1958) :132-39.

# *Bridging the Gap: The Geographer's World Is Everyone's World*

**DOUGLAS RICHARDSON**
**DAVID E. STEPHENSON**

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The application of geographical research to real world situations requires careful consideration of the actual circumstances under which such applications are likely to occur. In this paper we discuss the importance of establishing specific communications links between professional geography and the general public in any strategy for applications of knowledge generated by the discipline.

We assert that a "gap" or "gulf" exists between today's geography, as represented by the professional research discipline, and the public, defined broadly to include all people who might make direct or indirect use of the knowledge we in the discipline may have to offer. Though we cover much familiar ground, our points are specific. We argue that the gap described is a logical outgrowth of the very way in which the discipline has developed over the last several decades. We argue, furthermore, that the gap is a paradoxical development in the overall tradition of the discipline. Finally, we are confident that the gap can be bridged, and the analysis which is offered in this paper is directed toward this end.

We are not alone in asserting the existence of a gap. Our colleague Clarence Vinge recently asked in his review of the status of geography, "Why talk only to ourselves?" (Vinge 1975, p. 59). In a way, also, the focus of this volume acknowledges its existence. The gap is furter reflected in the widespread misconceptions that many Americans have about the nature of geography. The familiar stereotype of the field as the study of place names, exotic peoples, and capital cities is still with us. The ambiguous status of geography in American schools continues to be a problem. Erhard Rostlund (1956), in his perceptive evaluation of environmentalism, writes of yet another aspect of the gap. He points out that other Americans still view geography as the study of environmental influences. "We thus find ourselves in a curious situation.... A part of the reading public, which may be larger than we think, believes that geography is one thing, and most geographers say it is another."

How is it that this "curious situation" has arisen? What Rostlund describes has not always been the case. After all, the discipline grows out of a tradition rich in interaction with the public. Alexander von Humboldt was widely known in Europe. Could it have been that he deliberately wrote for the public? He stated as much in his preface to the *Kosmos* (Humboldt 1880). Much earlier, Strabo viewed geography as practical information for generals and public administrators (Jones 1917, pp. 16, 19). We can only envy the respect which geographers in Germany, France, and other countries have attained. L. Dudley Stamp was knighted for his work with the British Land Use Survey (James 1972, p. 277). The data base provided by that survey was an indispensable resource for wartime agricultural planning in Britain.

In the United States the early decades of this century were a time when geographers maintained vital contact with an interested and supportive public. The monographs written by the environmentalists were well known, widely circulated, and enthusiastically read. Whatever was to be thought of their work later, we cannot deny that the questions they asked and the topics they discussed interested a wide range of people. Huntington and his colleagues were able to write for both the profession and the public at the same time.

We in the profession are familiar with the adjustments that took place as the shortcomings of the deterministic perspective became apparent. The rejection of environmentalism was nearly complete, and that overreaction included, unwittingly, the appeal to the public. These developments marked the first appearance of the gap as a distinctive feature of professional geography in this country. Subsequent events contributed to a widening of this gulf between ourselves and the public.

What occurred from the 1920s onward was a good deal of groping about, a natural turning in of geography upon itself as new directions were sought. Members of the discipline were anxious to move out of the neophyte stage vis-à-vis the rest of the academic community. We do not argue whether or not this was a necessary development. It is unfortunate, however, that at the very time we were striving to enter the inner sanctum of respectability, the seeds were sown for further isolation.[1]

The maturing of a science is a slow and painful task; it should not be rushed. To hasten the process risks confounding the substance with the pretense of science. In geography the adoption of scientific terminology was swift. This reorientation, especially that beginning in the 1950s, led to much interesting and worthwhile work, read carefully and enthusiastically by other geographers. It also led to research which succumbed to the trappings or facade of science, rather than its essence. In some cases this took the form of a full-fledged retreat into scientism. The extent of this move is evident even today, where the free and inappropriate usage of scientific terminology has been attributed to "scientific faddism" (Newman 1973, p. 22; Harvey 1969, p. 141).[2]

A comparison with physics may clarify the bind in which we find ourselves. Physics is a field which seeks scientific explanation but is faced with the task of making difficult phenomena or inaccessible relationships comprehensible. It does this by relating them to common experience, often by analogy, and in so doing often approaches the explanation itself. In contrast, geography has the advantage of being able to start with familiar relationships and phenomena. For our analogies we have sometimes sought the more complex formulations in the physical sciences. There is a risk that these analogies are made more to achieve the appearance of scientific legitimacy than to provide explanation.

Our mention of familiar experience reminds us of the paradoxical situation in which we find ourselves. It is particularly ironic that this gulf has arisen in geography, for indeed, anyone who inspects the aspects of the world is in some measure a geographer. Stated more strongly, we believe that the energy that directs us in our enquiry is the very same energy that generates curiosity about the world on the part of everyone. The discipline currently does not utilize the potential of this common dynamic, yet its existence suggests that the discipline's present isolation need not be its permanent condition.

Moreover, as David Lowenthal points out, the *focus* of geographic enquiry is also fundamentally congruous with the objects and structures of common experience. More than in any other field, he argues, "the subject matter of geography approximates the world of general discourse; the palpable present, the everyday life of man on earth, is seldom far from our professional concerns." He goes on to state that "geography observes and analyses aspects of the milieu in the scale and in the categories that they are usually apprehended in everyday life" (Lowenthal 1961, p. 241). The geographer, then, may be the philosopher of the real world; he traffics in the wares of everyday experience. For better or worse, it is geography's privilege to deal, at least in part, with the commonplace. Thus, it is clear that the current isolation of the discipline, though understandable, is largely unnecessary, justified neither by tradition nor by the nature of our research. While this isolation may have at times served a positive function, it is now largely an encumbrance.

Looking back to our discussion of environmentalism, we find that the questions posed and the topics discussed were of interest to the public. The *Pulse of Asia* was widely read and appreciated; the discipline was known through its main research works. A *direct link* between the discipline and the public functioned as the route for knowledge transfer. This relationship might be depicted simply as in Figure 1.

Today the gap which had developed cannot be breached simply by printing and distributing more copies of standard research papers. The discipline has removed itself from the conceptual framework of common experience to the

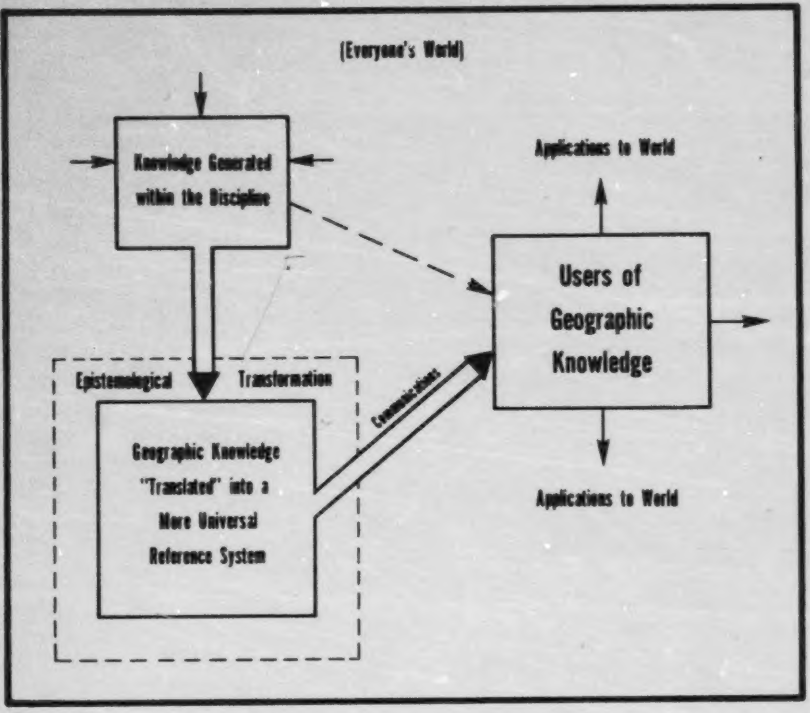
(Everyone's World)
Knowledge Generated within the Discipline
Applications to World
Users of Geographic Knowledge
Epistemological Transformation
Communications
Geographic Knowledge "Translated" into a More Universal Reference System
Applications to World

Figure 1

degree that the users' route to geographic knowledge is no longer a direct path to the discipline. What has happened? It could be that we are not asking interesting questions. At worst, it could be that our isolation has resulted in few people knowing what we are doing at all.

But along a different line, perhaps our questions are not put in a form which is accessible to those who share our curiosity, but not our concepts and training. In other words, are we talking about a simple communications problem or a more complex one, involving transformation from one reference system to another? We suggest it is both of these and that bridging the gap today implies a fundamental epistemological transformation during the communications process. The twofold step necessary for establishing the link to overcome the gap as it presently exists is represented in Figure 2.

Quite obviously, much of our research has considerable import at the public level, and geography has and will have much to offer in terms of applications. Yet the people who might find geographic research applicable to their situations need to be aware of what geography offers if those applications are actually to occur.

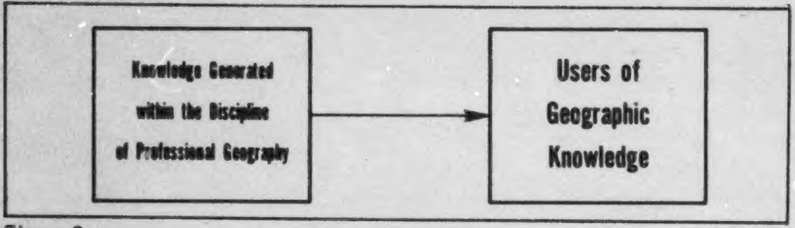

Figure 2

Our analysis indicates that we cannot assume that these links will automatically happen; on the contrary, recent history suggests that they will in fact *not* occur unless we see to it that they do.

In the diagram (Figure 2), we note a weak direct link between the discipline and the users. The first step, the transformation to a more accessible reference system, overcomes the epistemological gap, thus making the second step, communication with the users, much easier. Currently the discipline has no well-developed infrastructure for accomplishing these steps. In the recent past we have neglected our responsibility to connect with the outside, as we were preoccupied, perhaps necessarily, with internal adjustments of orientation (Ackerman 1963).

Thus, bridging the gap has now become a major task of the discipline and will continue to be so if geography progresses, as we believe it will, in the future. Geographers themselves must take the first step in forging the links which we see as essential to the vitality of the discipline.

* * * * * * * * * * *

Our task requires that we recognize a responsibility for looking beyond the surface impact of our work. Publication in the *Annals* is not the final step. The discipline's output must be put in a place and in a form where it will be seen and understood by others. We might begin to place more value on publishing options which reach a wider audience.

The recent heightened awareness of people-environment relations has produced a range of new journals and magazines which would seem to offer particularly suitable opportunities along these lines for geographers. They publish a mix of provocative and timely articles which often achieve an authentic interdisciplinary perspective, so often cited as important to geography, but less frequently in evidence. There is no reason that "popularization" of this sort should be disdained. Such an approach does require that attention be given to writing style, but need not imply a dilution of content.

We might also point out that even our basic research documents need not necessarily suffer a loss of substance with this orientation to audience and style. The vitality of the monographic literature in anthropology attests to the fact that primary research works, too, can have appeal beyond the confines of the discipline.[3] In his writings, Carl Sauer demonstrated that this can be achieved in geography (Sauer 1932, 1966, 1968).

The value to the profession of persons who can make the transformations of which we speak, who can crystallize concepts, translate jargon, and suggest implications of geographic research on a broad scale and in meaningful terms, should be clear. The stigma often attached to such activities must be removed. Other disciplines, perhaps more secure in their credentials, are not burdened with this attitude. In fact, top researchers in these fields often become key public spokespersons. Names like Kenneth Boulding, Margaret Mead, Jacob Bronowski, John Kenneth Galbraith, and James Watson come to mind. How many Americans today could name even one geographer, let alone say with any certainty what goes on within the discipline in terms of current research? The contrast apparent here emphasizes an earlier point, that the present estrangement of our discipline from the daily lives of many citizens cannot be ascribed simply to increased scientific sophistication or to a progressive maturation of the discipline, for the same citizens would have little trouble identifying at least some leading workers and research trends in other, either more or less scientifically mature disciplines, whether physics or biology, economics or psychology.

This comparison of disciplines suggests that, in addition to individual efforts, initiatives by the discipline, perhaps through its constituent organizations, could become important bridges of the gap. A task-force approach, along the lines of the High School Geography Project, might work. Perhaps a special publishing vehicle for conveying current research directions to the public should be encouraged. Successful models of this type include *Psychology Today* and *Scientific American*. Might we envision a *Geography Today?* On a smaller scale, journals such as *Landscape* and the now defunct *Places* deserve fuller support from the discipline.

It is true that the *National Geographic* exists already. Yet what demonstrates the irony of the gap more than the relationship of this magazine to the discipline? How many of us actually know an author or staff member of *National Geographic?* Though we recognize the excellence of this periodical, it is clear that its ties with the discipline are marginal and that it does not reflect current research trends.

Other types of contact may also open up new pathways to the public. Involvement with community projects, service-oriented university or governmental programs, and educational outreach all suggest such possibilities and should be explored. The potential for two-way communication which these alternatives present make them especially attractive. Efforts by some geographers have shown that public speaking can be a particularly effective means of linking geographic concepts to wider societal concerns.[4]

Clearly, no one prescription will serve to overcome the discipline's current isolation. Bridging the gap will require, however, that we acknowledge the fact of its existence and that we come to grips conceptually with the nature of the problem we face. Then links must be established through concerted action. The suggestions we offer indicate that many of these links, in embryonic form, can be identified in the discipline already and need only be developed.

## *NOTES*

1. One can only wonder how a discipline with an ancient history can perceive itself as "neophyte."
2. Newman (1973, p. 26), for instance, in a study of the use of the term "hypothesis" in geography, attributes its varied and indiscriminate usage to "the desire to invest a work with the aura of science, or at least the scientific method as proclaimed in the social sciences.... In their enthusiasm for demonstrating their scientific approach, many geographers have adopted just a word from the scientific method." He interprets "this confused state of affaris" as "the result of scientific faddism and pretentiousness."

   Along similar lines, David Harvey (1969, p. 141) states that the term "model" has become very fashionalbe in geographic research. In this respect geography is but a short distance behind the social sciences in general. As Brodbeck (1959, p. 373) has pointed out, "model-building has a kind of 'halo effect' upon the research worker since 'Models are Good Things'.... The general confusion surrounding the term is reflected in geographic research...."
3. Some examples from the monograph literature of anthropology include *Peasant Society and Culture* (Redfield 1956), *Argonauts of the Western Pacific* (Malinowski 1922), *Coming of Age in Samoa* (Mead 1928), *The Forest People* (Turnbull 1962), *Nomads of South Persia* (Barth 1964), and *Agricultural Involution* (Geertz 1963).
4. For example, see Georg Borgstrom's "World Feeding—An Education Challenge," a speech delivered to the Adult Education Association (Borgstrom 1975). In addition to writing successfully for a wider audience, Borgstrom is a frequent public lecturer and forum panelist.

## *REFERENCES CITED*

Ackerman, Edward A. "Where Is a Research Frontier?" *Annals of the Association of American Geographers* 53 (December 1963) :429-39.

Barth, Fredrik. *Nomads of South Persia.* London: Allen and Unwin, 1964.

Borgstrom, Georg. "World Feeding——An Educational Challenge." Address to Adult Educational Association meeting in Salt Lake City, Utah, November 1975.

Geertz, Clifford. *Agricultural Involution.* Berkeley: University of California Press, 1963.

Harvey, David. *Explanation in Geography.* New York: St. Martin's Press, 1969.

Humboldt, Alexander von. *Kosmos.* London: George Bell and Sons, 1880.

James, Preston E. *All Possible Worlds.* Indianapolis: Bobbs-Merrill, 1972.

Jones, H. L. *The Geography of Strabo.* Vol. 1. London: Heinemann, 1917.

Lowenthal, David. "Geography, Experience, and Imagination: Towards a Geographical Epistemology." *Annals of the Association of American Geographers* 51 (September 1961) :241-60.

Malinowski, Bronislaw. *Argonauts of the Western Pacific.* London: Routledge, 1922.

Mead, Margaret. *Coming of Age in Samoa.* New York: Morrow, 1928.

Newman, James L. "The Use of the Term 'Hypothesis' in Geography." *Annals of the Association of American Geographers* 63 (March 1973) :22-27.

Redfield, Robert. *Peasant Society and Culture.* Chicago: University of Chicago Press, 1956.

Rostlund, Erhard. "Twentieth-Century Magic." *Landscape* 5 (1956) :23-26.

Sauer, Carl. *The Road to Cibola*. Berkeley: University of California Publications, Ibero-Americana no. 3, 1932.

______. *The Early Spanish Main*. Berkeley: University of California Press, 1966.

______. *Northern Mists*. Berkeley: University of California Press, 1968.

Turnbull, Colin. *The Forest People*. Garden City, N.J.: Doubleday, 1962.

Vinge, Clarence L. "Jobs for Geographers." Report prepared for the university during consultant year, Michigan State University, Department of Geography, 1975.

# *Geographic Extension: Mandates, Means, and Methods*

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> The sixth planet...was inhabited by an old man who wrote immense books. "What are you doing here?" asked the Little Prince. "I am a geographer," said the old man. "What is that, a geographer?" "It's a scientist who knows about seas and rivers, towns and mountains, and deserts." "Very interesting," said the Little Prince. "Finally a real profession."
>
> Antoine de Saint-Exupéry, *The Little Prince*

The difficulty of defining *objectum estudiandi* and the lack of demonstrated applicability are major reasons for the unelevated, not to say disputed, status of geography as a science. While geographers tend to agree on the basic subject matter of the discipline, we are often hard put to convince our academic colleagues that the geographer's contributions to knowledge are autochthonous, spring from a solid methodological base, and include an array of self-developed techniques. In spite of what we value as meaningful research in physical and human problem areas, geography still is not represented in allegedly encyclopedic treatises of the natural or social sciences. Furthermore, considering the low esteem in which geography is held by those responsible for deciding upon the subject matter at foundational levels of the educational system, and observing the meager number of geographers employed by public and private organizations, it seems logical to conclude that geography is generally considered as neither an essential field of learning nor a domain of knowledge requiring distinctive professional skills.

We believe that one of the principal reasons for the insecure position of geography in both the academic and the professional community is our failure to establish among the general public a platform on which the relevance of research for regional reality could be introduced, demonstrated, and propagated. Although few intellectual interests are as universal among people as that relating to place—the innate satisfaction in knowing one's own locale and how it relates to elsewhere—it is not nurtured by the professional geographer. Nor is the same general populace aware of the fact that geography has applicable phases as well as academic merits.

Since everyone knows, in greater or lesser degrees, about the place called home, and because many pride themselves in knowing even foreign places through a self-learning experience called tourism, it may not occur to this mass of lay geographers that the complex relationships between people and land, inherent to these places, may constitute the object of serious scientific study. Thus, until geography is conceived by society as a research-oriented, problem-solving, and utilitarian science of space and place, practiced by an essential professional, known as geographer, the status quo will prevail. In the discipline's quest to make its message better known, there can be no doubt about the importance of employing methods that will establish the most firm underpinnings of disciplinary support—popular recognition.

## *THE MANDATES*

As far as responsibility toward the populace is concerned, a mandate appears implicit in the cultural hearth of the nation. It seems that only from a society that evolved from geographic discovery could a populace steeped in geographical awareness be derived. Through recognition of the nature of agricultural development in such a setting, the significance of the "man-land" relationship diffused ether-like through the people, so as to make its presence numbed by its very existence. While there was a strong awareness of the geographical setting which had its sure effect upon the people and their burgeoning culture, this did not result in the obvious identification of geography as an applied science.

Given this peculiar nature of geography in the collective consciousness of our ancestors, it is not at all surprising to note that an applied geography was not recognized by those educational leaders who were convinced that America needed a system of education especially adapted to a new country and an underdeveloped agriculture. Colleges in the United States, throughout the first half of the nineteenth century, were largely transplants from the Old World educational system which emphasized a classical curriculum. However, in 1855 the Agricultural College of the State of Michigan "was directed to improve and teach the science and practice of agriculture. It was charged to teach an 'English and Scientific Course.' This was the common title of the nonclassical course in institutions which had broken thus far with tradition; it normally included an introduction to various sciences and extensive study of English language and literature, mathematics, philosophy, ***geography***, political economy, and history" (Kuhn 1955, our emphasis).

With the first Morrill Act in 1862, the concept of education tailored to the needs of a pioneer people became a reality. It was that Federal Act which stipulated that in land grant colleges "the leading object shall be, without excluding other scientific and classical studies...to teach such branches of learning that are related to agriculture and the mechanical arts...in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."[1]

Although geography had already been recognized as a discipline at the time when the Michigan Agricultural College became one of the land grant schools in 1863, our predecessors must have had difficulty convincing an agriculturally oriented adminstration that geography could be applicable to the "grass roots" level. But, by the time of the Smith-Lever Act[2] in 1914, geographers had begun to organize themselves in this country, and there is evidence that action was taken to incorporate geography in the Cooperative Extension Service of Michigan.

Indeed, James (1972) considered the first official land use survey in the United States, the Michigan Land Economic Survey, as a major effort to apply "ideas generated in professional discussions to real practical problems" (p. 439). It is interesting to note that one of the most outspoken proponents for the Survey was not a specialist in any of the "resources," not one who wanted to popularize geography, not a politically oriented or practically minded person, but a man with keen insights into nature and people as its transformer. He realized that the problems of cut-over lands in Michigan were not solely those of the forester or the agricultural extension specialist. These problems were shared by the geographer who, he insisted, should study land utilization as just one dynamic aspect of "Morphology of Landscape" (Sauer 1925). It is also symptomatic for their concern with contemporary issues that Michigan geographers organized a special session at the 1921 meeting of the Michigan Academy of Sciences, Arts, and Letters under the theme "Michigan's Idle Lands" (Lovejoy 1921) in which the aforementioned survey was postulated. Indifference toward making one of our well-established survey techniques—land use mapping—better known is clearly attested by the fact that the land classification maps of Michigan counties drawn in the 1920s and 1930s (Davis 1969) are gathering dust in little-used library drawers.

It is appropriate to ask at this point why geography, with a historically evident applicability, failed to take advantage of either the popular or the legislative mandate. Why, particularly in land grant colleges with their tripartite function of research, teaching, and distribution of knowledge through extension, did geography not participate in the popularization of its research methodologies and products? Is it because of the centurial quest that set geographers out to prove the scientific *raison d'être* of their discipline, thereby avoiding the more pedestrian aspects of their practice—exactly those aspects which would have instilled in the general populace the distinct belief that geography would, and could, be of useful and practical value?

We submit that this prolonged navel contemplation, supplemented by a traditionally nonapplied "academic" research orientation, led to the discipline's indifference to societal problems. As a principal concern, the search for values and relevance in the pursuit of geography is quite novel in methodological discussions, with Buttimer (1974, p. 13), for instance, asking why geographers should not apply themselves to existing problems, accept a vocational commitment rather than "assume that somehow demand is a relatively fixed function, and supply must be channeled toward existing vacancies." Vinge (1975, p. 37) expresses the same concern: "For the future it seems inevitable that the increase in number and complexity of society's problems...will push the nation's intellectual-resource centers into taking greater interest in what many scholars, unfortunately, consider mundane difficulties—difficulties with which other people in other types of institutions should cope." Nor does it appear that the "revolutionary movement" in the profession in the past decade has had a noticeable impact on career choices of students. In a survey of some 800 doctoral candidates in geography in 1971 (representing approximately 60 percent of the group then in residence), Hart (1972, p. 24) finds it "rather frightening to discover that these candidates do not seem to have a very high opinion of nonacademic careers," after less than 10 percent indicated that they would prefer off-campus employment upon graduaation. There is little doubt that the social mandate, so sharply voiced by some of our colleagues, is not yet a driving force in changing our professional attitudes toward applied goals, some meritorious efforts in this direction notwithstanding.

## *THE MEANS*

The crucial question, then, is how knowledge of place can be made more meaningful to the public. Let us not fool ourselves: geographic literature of the scientific genre, whether meant to be applicable or not, rarely is read beyond the boundaries of our academic province and, even less, used for practical purposes in the public forum. If we consider that decisions on "man-land" issues are made by public officials relying on a host of specialists who seem to be able to take care of the order of the day without consulting an assumedly—and by definition!—knowledgeable professional on such issues, the geographer, our plight on the applied front becomes most evident.

The main problem, of course, is the lack of middlemen, or agents in the marketplace who could distribute and demonstrate the geographer's laboratory products to the consumer. It is here where progress must be achieved, and perhaps we don't need to look very far for a potentially successful medium to diffuse the stock of geographic knowledge to the public. After all, knowledge is already very efficiently dispersed off-campus on matters relating to agriculture and natural resources in this country. Considering that our expertise in, as well as our approach to, the study of the rural landscape and its resources can stand on its own merits, it seems that academic geography should make use of this already established channel of communication between the university and the hinterland. As far as the local situation is concerned, the Cooperative Extension Service of the College of Agriculture and Natural Resources of Michigan State University employs two deans, six program directors, more than 600 persons active in county extension offices, and, most impressive of all, some 35,000 volunteers, all of whom "play a vital role in multiplying Extension's educational efforts and reaching the people of Michigan" (Michigan State University 1975).

A closer look at the nature of the programs that the Cooperative Extension Service presents to the people of Michigan makes our potential contributions to this organization become apparent. While originally the Service was "to aid in diffusing among the people...useful and practical information on subjects related to agriculture and home economics, recent activities include, under the general heading of Natural Resources and Public Policy Programs: (a) awareness for land-use and zoning, (b) analysis of ecosystems and environmental quality, (c) parks and community development, (d) rural recreation, and [even] (e) programs for people in small towns, suburbs, and central city" (adapted from Michigan State University 1976).

Significant contributions in research and teaching have been made by geographers to these areas of public concern, and it seems that, with the College of Social Science at Michigan State University deemed as one of the supportive units through which extension specialists may be made available, there exists an excellent opportunity to apply our expertise within the framework of the Cooperative Extension Service by making the substantial geographic documentation of Michigan reach local levels. However, we would surely need to demonstrate with convincing examples that *geographic extension* would, indeed, be "useful and practical" to justify inclusion in the applied operations of the Service.

One of the most promising ways for the geographer to reach "grass roots" or "street corner" levels could be to function as a documentarian of the changing scene. A case in point is the innovative and painstaking characterization by the Detroit Geographical Expedition of an inner-city milieu, which must stand as the *pièce de résistance* of those who advocate personal involvement as a mandate for disciplinary legitimacy (Bunge 1969). In this venture academic expertise was applied, local citizens' experience was drawn upon, and direct social benefit accrued for the local populace. The monograph on Section 16, T1S, R11E of Michigan (Fitzgerald) remains a benchmark in the literature of socially involved urban geography (Bunge 1971).

There are other examples of a more meaningful local or regional geography. As of yet a quite small, but certainly distinguished, group of North American geographers have made it their goal to promote county monographs and regional guidebooks in which the geographic approach in the studies of people and landscape is demonstrated (Swain and Mather 1968). The efforts of these pioneer *County Geographical Societies* deserve serious attention as they have considerable potential for enhancing the visibility of geography among the people in their local environments.

## THE METHODS

With the mandate and the means now introduced and established, it could be said that we have merely taken part in yet another interesting academic self-examination. That is, if we were not to present a call for deliberate action to be initiated through a concrete *modus operandi.* Instead of charging individual members of our discipline with paying little or no heed to the mandates, we prevail upon them, as an ensemble, to participate in the production of an action plan for the implementation of a strategy for the application of geography. This step is essential if we, collectively, have the interest and desire to take advantage of the available means through an applied program of *geographic extension.*

As stated previously, some of our associates do at present participate in various forms of "extended geography." And it might be appropriate to note that these limited applications are frequently observed in the work of those in our company who entertain a noticeable "field work" orientation, be that in the physically or socially oriented systematic branches of the discipline. Much work done in cartography and remote sensing is of utilitarian nature.[3] The significance of the term "extension," for our purposes, is grounded not in what one investigates but in how one proceeds when conducting research.

The first phase of an action plan requires the concentration of research within a specific locale or spatial unit. Given that the number of professional participants would be limited, so, too, should the areal extent of the extension laboratory. However, careful consideration must be employed when choosing such a site. It should be a well-defined geographical area (in the literal sense), satisfactory to the participants. Thus, there would be assurance that all those involved might feel as though the promise for successful attainment of research objectives could exist therein. Furthermore, the area should be a distinct political unit situated in advantageous proximity to the institution from which the extension activities would emanate. In this manner one should achieve: (1) contact with elected and/or appointed unit officials; (2) ease of actual entrance to and egress from the study area; and (3) the eventual facility of two-way interaction between people, ideas, and product.

In the second phase a recognition of the professional discipline of geography must be developed within the local populace. As we all recognize, for some the current colloquial definition of geography is still couched within the phrase of "locating and naming of states and state capitals." Only with noticeable geographic research activity and by the dissemination of meaningful results through those media accessible to the layperson can this definition be broadened in such a manner as to be more nearly compatible with our own.

It might also be that the guidelines of this phase could lead to the formation of actual *"geographical expeditions."* Therein, an allowance is provided for the education of university students through the field work experience. Upon completion of these group projects, individual graduate students might develop certain attachments to the area, and they might then be encouraged to choose their respective thesis topics from among the already reconnoitered problems of the extension territory. In this way the extended value of the original faculty commitment could be increased several times over in a short time span and guarantee the continuity of the effort.

Upon successful demonstration of the value of geographic field research, the last phase may be implemented in which the populace becomes directly, rather than passively, involved. Given the continued demonstration of the practicality of the geographic approach, a certain number of local inhabitants will have become interested in what "the geographers are doing." This is an extremely important facet in the securing of successful geographical extension. This interest should be encouraged and nurtured, even to the point of personal sacrifice—in terms of time and remuneration, for instance—on the part of the extensionist geographer. In the beginning, success will be easier if the professionals, or their students, take part in activities such as volunteering to assist a high school geography teacher formulate a curriculum and conduct field trips, assisting a group of interested citizens to organize a county geographical society and produce meaningful findings, or emphasizing the availability of research expertise and display techniques to be used effectively within the local problem-solving format.

Once these phases have been actuated and appropriately maintained, popular recognition will be made manifest. Although at our present juncture this method may be perceived as a big step—perhaps even an uncertain one—is it intrinsically any greater than that made in 1914 which fostered the concept of cooperative extension in the first place? We think not and call upon those who have expressed other themes of applicability in this volume to collaborate to build a program which utilizes our abilities productively and to return the recognition so necessary for the promulgation of geography. Let us respond to the mandate and be worthy of the means—through our own distinctive manner of spatial analysis—the geographical method.

## *CONCLUSION*

Although there have been occasional efforts in the profession to make the results of geographic research more useful to society, we have not succeeded in developing a marketable product universally recognized as geographic and applied to reality by the professional geographer. A graduate of our discipline must often use such pseudonyms as "regional specialist," "resource analyst," or "cartographer" to make his or her expertise known in the nonacademic labor market. If a few thousand geography graduates had the opportunity over the years to pursue nonacademic careers and if some have even reached positions of influence, the fact remains that "geographer" is still a rarity on the professional roster.[4]

The question is whether we are going to continue to do "our own thing" or whether the necessary adjustments can be made to fulfill the mandates which always seem to have been there: to assume a greater *educational responsibility* by extending our wisdom about places beyond campus confines, to respond more actively to the *popular demand* for geographic knowledge, and to recognize more fully a *vocational commitment* to utilize geographic perspectives in questions which concern people and the environment. The importance of being earnest about the problem at hand, we think, cannot be overemphasized. There may no longer be any interest in a geography that fails to return the fruits of its academic harvest to those who tacitly support its institutional existence—while the fruits of that unplucked orchard yearly become less and less palatable.

## *NOTES*

1. Act of the Thirty-Seventh Congress, 1862: "An Act donating Public Lands to the several States and Territories which may provide Colleges for the Benefit of Agriculture and the Mechanic Arts." It was followed by an Act of the Fifty-First Congress, 1890, which appropriated "twenty-five thousand dollars to be applied only to instruction in agriculture and the mechanic arts, the English language and the various branches of mathematical, physical, natural, and economic science, with special reference to their applications in the industries of life and the facilities for such instruction."
2. Smith-Lever Act, 38th Statute, Law 372 (1914). The Federal act established the Cooperative Extension Services between the land grant colleges and the U.S. Department of Agriculture. Ten amendments to the original legislation were consolidated in 1953 as Public Law 83 of the 83rd Congress. The Michigan Legislature accepted the benefits of the Federal act under Michigan Public Act 65, Laws of 1915. Seven amendments and additions have been made since that time to state legislation.
3. For example, see the practical applications demonstrated by the Remote Sensing Project for Improved Land Use Policy and Management of Michigan State University (Hill-Rowley et al. 1975).
4. Note, however, the position of Chief Geographer in the United States Geological Survey!

## *REFERENCES CITED*

Bunge, William W. *The First Years of the Detroit Geographical Expedition: A Personal Report.* Detroit: Society for Human Exploration, 1969.

______. *Fitzgerald.* Cambridge, Mass.: Schenkman, 1971.

Buttimer, Annette. *Values in Geography.* Commission on College Geography Resource Paper 24. Washington, D.C.: Association of American Geographers, 1974.

Davis, Charles M. "A Study of the Land Type." In *The Michigan Land Economic Survey,* pp. 15-41. Office of Research Administration Project 08055. Ann Arbor, Mich., 1969.

Hart, J. Fraser. *Manpower in Geography: An Updated Report.* Commission on College Geography Publication 11. Washington, D.C.: Association of American Geographers, 1972.

Hill-Rowley, R., M. Boylan, W. Enslin, and R. Vlasin. "Improved Resource Use Decisions and Actions Through Remote Sensing." In *Proceedings of the Earth Resources Symposium,* vol. 1C, pp. 1747-67. Houston: Johnson Space Center, 1975.

James, Preston E. *All Possible Worlds: A History of Geographical Ideas.* New York: Odyssey Press, 1972.

Kuhn, Madison. *Michigan State: The First Hundred Years.* East Lansing: Michigan State University Press, 1955.

Lovejoy, P. S. "The Need for a Policy for the Cut-Over Lands of Michigan." In *22nd Annual Report of the Michigan Academy of Sciences, Arts, and Letters,* pp. 5-7. Ann Arbor: Michigan Academy of Sciences, Arts, and Letters, 1921.

Michigan State University, Cooperative Extension Service. *Where the Action Is.* East Lansing: Cooperative Extension Service, Michigan State University, 1975.

———. *The Cooperative Extension Service: A Guide Prepared for County Boards of Commissioners.* East Lansing: Cooperative Extension Service, Michigan State University, 1975.

Sauer, Carl O. "The Morphology of Landscape." In *University of California Publications in Geography* 2, pp. 19-53. Berkeley: University of California, 1925.

Swain, Sheldon and Cotton Mather. *St. Croix Border Country.* Prescott, Wis: Trimbelle Press, 1968.

Vinge, Clarence L. *Jobs for Geographers: Views by Members in the Profession.* Report prepared for the university during consultant year 1975. East Lansing: Michigan State University, Department of Geography, 1975.